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Popular Mechanics

THE TECHNOLOGY WAR

**WHO'S REALLY AHEAD—
THE SOVIETS OR US?**

■ In Weapons ■ In Space ■ In Medicine
■ In Energy ■ In Transportation

**HOTTEST
NEW GADGET:
ELECTRONIC
NOTEBOOKS**

**A Mini-Computer
In Your Pocket**

DREAM CARS FOR SALE
Detroit Showcars You'll Be Able To Buy

A U.S. Navy SH-60 dips sonar for a Soviet Akula-class sub, which sails faster and dives deeper than anything we have.

BONUS SECTION

BATHROOM REMODELING

HOW TO:

- Set Tile
- Build Vanities
- Install Skylights
- Replace Fixtures
- Recess Lighting
- Create A High-Fashion Look
- And More!



WHY AMERICA A CHANGE OF HE

**CHEVY SPORTSIDE. MORE V6 POWER
THAN FORD, STYLED LIKE NO TRUCK
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See the Chevy Sportside at your Chevy dealer's. In either 2- or 4-wheel drive. And you'll

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NOT MADE.



84 COVER STORY

Great advancements in science and technology are illuminating the future for the Soviet Union. And we got a firsthand look—at hardware from sub to space capsules. —PM illustration by Ed Valigursky



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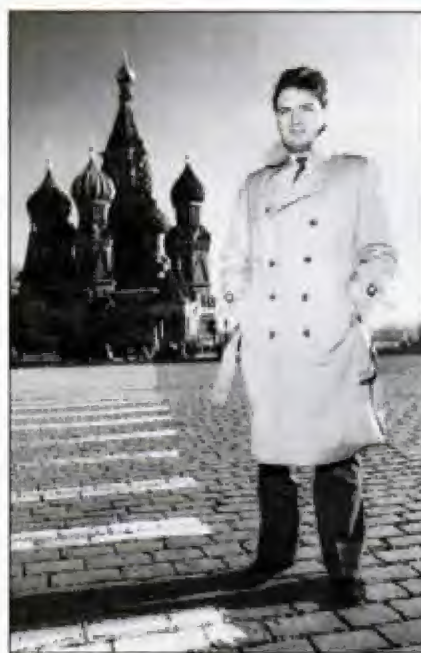
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EDITOR'S NOTES

Popular Mechanics

THIS IS THE year for everyone to love the Soviet Union. Mikhail Gorbachev started it last year with his *glasnost* policy of openness. And there is definite improvement in relations between the U.S.S.R. and the U.S. However, that doesn't mean we aren't still concerned about maintaining our competitive edge in many arenas where both countries have an interest. Discussing such issues inevitably leads to a debate over whether we or the Soviet Union are ahead in space, in weapons technology, in medicine and in other disciplines. We wondered, too. So we dispatched Science/Technology Editor Tim Cole to the Soviet Union to get the inside story. Cole spent three weeks there, touring the leading technology centers and interviewing the Soviet Union's top scientists and engineers. His cover story, "Red Tech Rising" on page 84, is both fascinating and reassuring. We're doing okay in most areas, but there's work to be done in others. I hope our new leadership in Washington will recognize this, too, and give new direction to programs which will make America a world leader in virtually all areas of science and technology—as we once were. . . .



Cole in Red Square, Moscow.

Reader Harry Oakes of Glen Mills, Pennsylvania, wrote me a letter recently that said, in part: "Many of your covers over the years have been graced with the work of Ed Valigursky, whose fantastic artwork has surely whetted the appetite of many a person to buy PM and read the inside story. How about an article on this unsung hero." We can't do a whole article on Ed, but his work surely has graced many of our covers, including this month's. Ed Valigursky is one of the country's best-known illustrators of aircraft, ships, spacecraft and other machines. He is the regular illustrator for our popular "Tech Update" section (page 13) and his paintings are on permanent exhibit in such places as the Pentagon, numerous naval and air force installations, and in the offices and homes of corporate and government officials. Ed is a member of the American Society of Aviation Artists and the Society of American Historical Artists, and his work has garnered him numerous awards over the years. We're proud that Ed is part of the POPULAR MECHANICS family. . . .

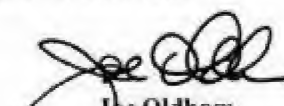


Ed Valigursky



Ron Riker

From time to time, we call on outside experts to help us produce the articles you see in POPULAR MECHANICS. This month, general contractor and master carpenter Ron Riker of Keyport, New Jersey, helped us produce our "Bathroom Remodeling Guide," which begins on page 93. Riker has the unique ability to articulate what he's doing so that our writers can capture his knowledge and expertise for the pages of PM. And that's a rare gift. 'Til next time.


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Bill Hartford

Graphics Director
Bryan Canniff

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Joseph Truini, shop and tools editor
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Norman Becker, Rosario Capotosto,
Steve Toth, Bob Vila,
contributing editors

Electronics/Photography

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Art

Alan Andresen, Tom Kane,
associate art directors
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Editorial Administration

Josephine Caronia, administrative assistant
Barbara A. Novak, asst. to the editor

Editorial Offices

224 West 57th St., New York, NY 10019
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16 mg "tar," 1.0 mg nicotine av. per cigarette, FTC Report Feb. 85

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Popular Mechanics

Publisher
Daniel J. Coleman

Director Of Advertising
Warren R. Schultz
National Sales Manager
William T. Duke
Director Of Marketing
Edward Vaquero

Advertising Offices

New York

224 West 57th St.
New York, NY 10019
Brian Broderick, New York Manager
(212) 649-3135
Edward W. Baker - (212) 649-3141
Alfred R. duPont - (212) 649-3142
Timothy Poturny - (212) 649-3140

Chicago

1 South Wacker Dr.
Chicago, IL 60606
(312) 984-5190
Alan R. Perry, Western Manager
F. Lee Bishop - (312) 984-5194
Daniel F. Kellner - (312) 984-5195

Detroit

2301 West Big Beaver Rd.
Troy, MI 48064
Laurence E. Lantzy - (313) 649-2981
Donald C. Schulz - (313) 649-2981

Los Angeles

3000 Ocean Park Blvd.
Santa Monica, CA 90405
Penn H. Jones - (213) 450-8881
Austin C. Sass - (213) 450-8881

Direct Response Advertising

224 West 57th St.
New York, NY 10019
Bud Gilbert, Manager - (212) 649-3139
Dan Nunziata - (212) 649-3143

Business Manager

Agnes P. Maillaro

Production Manager

Lori Ellwood

Advertising Production

Patricia A. Tanner - (212) 649-3164

Classified Sales Manager

Sophie Gronowicz - (212) 649-3167

Reader Service Department

Norah I. Golad, supervisor
224 West 57th St., New York, NY 10019
(212) 649-3128

Published by The Hearst Corporation:

Frank A. Bennack Jr., President
Randolph A. Hearst, Chairman
Gilbert C. Maurer, President, Magazines Division
D. Claeys Bahrenburg, Exec. Vice President
Richard E. Deems, Publishing Consultant

POPULAR MECHANICS is published monthly by the Hearst Corporation, 959 Eighth Avenue, New York, NY 10019, U.S.A. Frank A. Bennack Jr., President; Randolph A. Hearst, Chairman; Harvey L. Lipton, Vice-President and Secretary; Edwin A. Lewis, Vice-President and Treasurer; Hearst Magazines Division: Gilbert C. Maurer, President; D. Claeys Bahrenburg, Executive Vice-President; K. Robert Brink, Executive Vice-President; George J. Green, Executive Vice-President; Mark F. Miller, Executive Vice-President, General Manager; Raymond J. Petersen, Executive Vice-President; Thomas J. Hughes, Vice-President & Resident Controller; Daniel J. Coleman, Vice-President for Popular Mechanics.

INTERNATIONAL EDITIONS: CARIBBEAN, MEXICO, SOUTHERN HEMISPHERE

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An Engineering Masterpiece That Performs as Beautifully as It Looks

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WATCH FOR THIS MARK

IT MEANS
THE PRODUCT
HAS BEEN
FEATURED IN PM

LETTERS

A Place To Work

I WANTED TO let you know how much I enjoyed building the handsome red oak desk that appeared in your story, "Working At Home," in the Woodworking Guide of Nov. '86 (page 114).

The plans, which were shown complete on one page of the story, were easy to follow and all the dimensions worked out exactly. I made two changes: I deleted the center drawers, and I increased the depth to 30 in. Thanks for the terrific place to work!

LEIGH SMITH
APISON, TN

Building instructions with detailed photos and plans for our contemporary desk were presented in a 6-page story. Photocopies of the story are available for \$4.50 from POPULAR MECHANICS, P.O. Box 1014, Radio City Station, New York, NY 10101.



PM's contemporary desk features storage space and shelf for a typewriter.

Photo History

Your "Portraits" article (page 58, Jan. '89) overlooked the Exakta as the first 35mm single-lens-reflex camera. I bought my 1936 Kine Exakta in 1941, and carried it with me to Guam during World War II.

ALLAN P. MILLER
BALTIMORE, MD

You and several other readers have correctly pointed out that the Kine Exakta predates the 1952 Asahiflex. In calling the Asahiflex the first "widely available" SLR, we should have noted that World War II interrupted regular shipments of the German-made Exakta to the U.S. market. Moreover, supply remained inconsistent with the onset of the Cold War, as the Exakta plant was located in Dresden, beyond the Iron Curtain in Russian-occupied East Germany.

Hot Tip

Among all the vehicles that I've had over the years, and that I have now, my pride and joy is the 1971 Chevrolet Sub-

urban 4-wheel drive. I keep my vehicles in excellent running order.

POPULAR MECHANICS, more specifically, "Saturday Mechanic," has been an excellent guide to me.

Of the many ideas that I owe to POPULAR MECHANICS, probably the most helpful was taken from the Car Care Tip titled Cold Heat in "Car Clinic" of the Dec. '88 issue (page 38).

My 1971 Suburban was not putting out enough heat. Like your contributor from Alaska, I went through the litany of checks and replacements. I talked with the experts and they had nothing to offer. Then, I likewise found the heater core smothered with bugs and leaves. Now I have warm air once again.

ROZIER E. SANCHEZ
ALBUQUERQUE, NM

Clean Machine

In your article "How To Maintain Your Chain Saw," (page 101, Jan. '89), you suggested using a wood stick to clean

out the chain bar groove. I've found that it's very hard to get a wood stick thin enough to fit in the groove and still have enough rigidity to remove debris. I would suggest using a piece of old hacksaw blade. Wrap tape around it as a handle. The teeth are perfect for cleaning around the lube oil holes on the bar.

TOM IVANOFF
PEOTONE, IL

Lab Notes

Thanks for the camcorder tests in your Dec. '88 issue ("Camcorders On Trial," page 72). I'd been in the market for a camcorder for some time, but could never get adequate explanations for all the performance specifications cited by the manufacturers. Your "real-world testing" helped interpret the numbers. Thanks, again.

DIRCK McDOWELL
AVON-BY-THE-SEA, NJ

Glad we could assist you and other electronics buffs. In our next test report, we'll examine the latest compact disc players.

PM



Courage for your car.

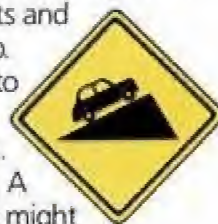
Does your car turn into the gutless wonder on a hill? Does it crawl instead of climb? Do you press the pedal too much for too little acceleration?

Your car's lack of courage could mean dirty fuel injectors are robbing it of power.

But one bottle of STP® Super Concentrated Fuel Injector Cleaner quickly dissolves deposits and unclogs grimy injectors. It helps restore lost power and improve acceleration. Helps eliminate tough starts and rough idling, too.

And it's so easy to use, just add it to your gas tank.

So take heart. A dose of courage might be all your car needs to perform better.



B FIRST BRANDS



THE BEST-SELLING COMPACT TRUCK

THE NEWLY DESIGNED 1989 FORD RANGER XLT.

We took the best-selling compact truck in America* and made it even better for you in 1989. Because you don't stay on top by standing still.

IT'S WHAT'S NEW IN COMPACT TRUCKS.

Ford Ranger XLT's changes for 1989 start with a new, more aerodynamic exterior styling and continue inside the cab, where the improved interior environment features redesigned seating and a newly designed instrument panel with tachometer. Thanks to its 2.3L Dual

Plug engine, this year's Ranger XLT features more horsepower than last year's model. And also this year, Ranger XLT features standard anti-lock rear brakes.

IT'S A LOT OF TRUCK FOR THE MONEY.

With so many new features—and some returning favorites like a fully synchronized five-speed trans-





IN AMERICA JUST GOT BETTER.

mission, power steering, tinted glass, and AM/FM stereo cassette — you might think Ranger XLT can't possibly be a bargain. But Ranger XLT gives you all that, plus Twin-I-Beam Front Suspension, 60/40 cloth split bench, and all-season radials for a price that just might surprise you.

6/60 WARRANTY.

Covers you and future owners, with no transfer cost, on major powertrain components for 6 years/60,000 miles. Restrictions and deductible apply. Ask to see this limited warranty at your Ford Dealer.

STANDARD XLT B64A PACKAGE EQUIPMENT:

Power Brakes (rear anti-lock); Gauge Package; 60/40 Cloth Split Bench; P215 All-Season Radials; Chrome Rear Step Bumper; Elec. AM/FM Stereo w/Clock and Cassette; Power Steering; Tachometer; Sliding Rear Window; Deluxe Two-Tone Paint; Tinted Glass.

CAB AVAILABILITY

Regular Cab; SuperCab.

DRIVETRAINS:

2.3L I-4 Dual Plug Engine; 5-Speed Manual Overdrive; 4-Speed Column-Mounted Auto. Overdrive (Optional).

BEST-BUILT AMERICAN TRUCKS 8 YEARS RUNNING.

Ford Trucks are the best built — based on an average of owner-reported problems in a series of surveys of '81-'88 models designed

and built in North America. At Ford, "Quality is Job 1."

*Based on 1988 calendar year manufacturers' reported retail deliveries through 10/31/88.

Buckle up—together we can save lives.



RANGER
BUILT FUN TOUGH

TIME MACHINE

75 YEARS AGO: APRIL 1914



Big Wheel

In early incarnations, PM became a repository for the bold, the visionary—or the merely wacky. Consider one form of personal transportation from a St. Louis inventor: Our propeller-driven cover subject consisted of a rubber-rimmed aluminum wheel that turned on a stationary wheel inside it. A 3-cylinder reciprocating-piston engine powered the machine, and the driver perched within the inner rim. The motorecycle quickly extinguished popular demand.

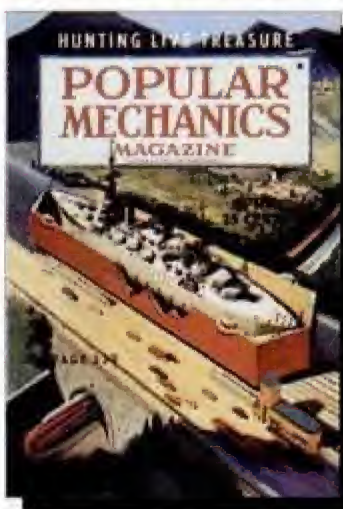
Air Progress

PM was present at the creation of numerous industries, but none was covered with as much passion-filled detail as aviation. Traveling to aviation's early R & D center in Hammondsport, New York, PM learned that pioneer Glenn H. Curtiss and his colleagues were discussing "the ever-present possibility of transatlantic flight." Nascent air-to-air

refueling schemes were advanced, along with a scenario that envisioned dirigibles serving as flying landing strips. The Navy's later airship fleet would carry squadrons of tiny biplanes.



50 YEARS AGO: APRIL 1939



Ship Movers

The Maginot Line had amply demonstrated the French focus on massive military projects and procurements. Nothing could compete, however, with the plan illustrated on PM's cover to transport French warships from the Med to the Atlantic by rail. Desiring to eliminate the sail around the Iberian Peninsula—thus avoiding the chokepoint at Gibraltar—the 6-track ship hauler would link Port de Verdon and Beziers over rivers and through mountain passes.

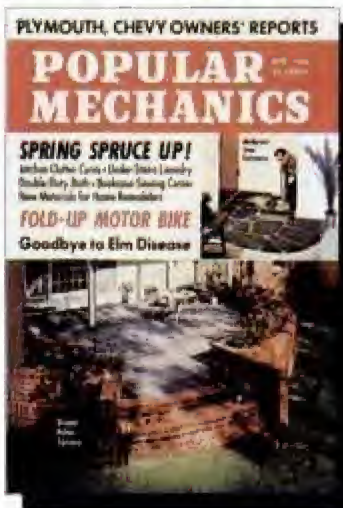
Three-wheeler

The benefits of fuel efficiency were becoming a serious issue for motorists. One solution: Lighter cars propelled by smaller, fuel miserly engines. We published one concept that called for the

elimination of one back wheel altogether, a 60-hp, air-cooled engine and welded 1-piece body construction that replaced heavy nuts and bolts.



25 YEARS AGO: APRIL 1964



Spring In The Air

A quarter-century ago, articles on how to create a shipshape exterior served PM's growing legion of do-it-yourselfers. New low-maintenance sidings made of galvanized steel, vinyl and plastic were reviewed, along with step-by-step installation help that has become a PM hallmark. Elsewhere, we furnished 14 spring projects—from slate entrances, to concealed hobby walls that miraculously absorbed childhood toys, chemistry experiments and other items.

Working In Space

Americans were taking their first tentative steps toward the stars, and the need to construct orbiting platforms struck a sympathetic chord with PM readers. We reviewed an electric ratcheting device made by Black & Decker that overcame the reaction created by a turning force in space. Its freely rotating motor and mechanisms transferred

both power and reaction from the motor to the output shaft. A busy spacewalking astronaut could convert it from a wrench to a screwdriver or thread tap. **PM**





**"HOW GOOD'S
THE NEW
AC DURAGUARD
OIL FILTER?
TWICE AS GOOD."**

—Chuck Yeager

AC's new Duraguard Oil Filter is so good, it's designed to cut engine wear in half, compared to old AC filters.

Up to fifty percent less engine wear. Thanks to a new glass medium designed to trap more sludge and crud.

Your car's a big investment. Doesn't it make sense to give it the most protection you can? With oil filters that match your car's performance requirements to a "T"? AC Duraguard Oil Filters.

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GENERAL MOTORS CORPORATION

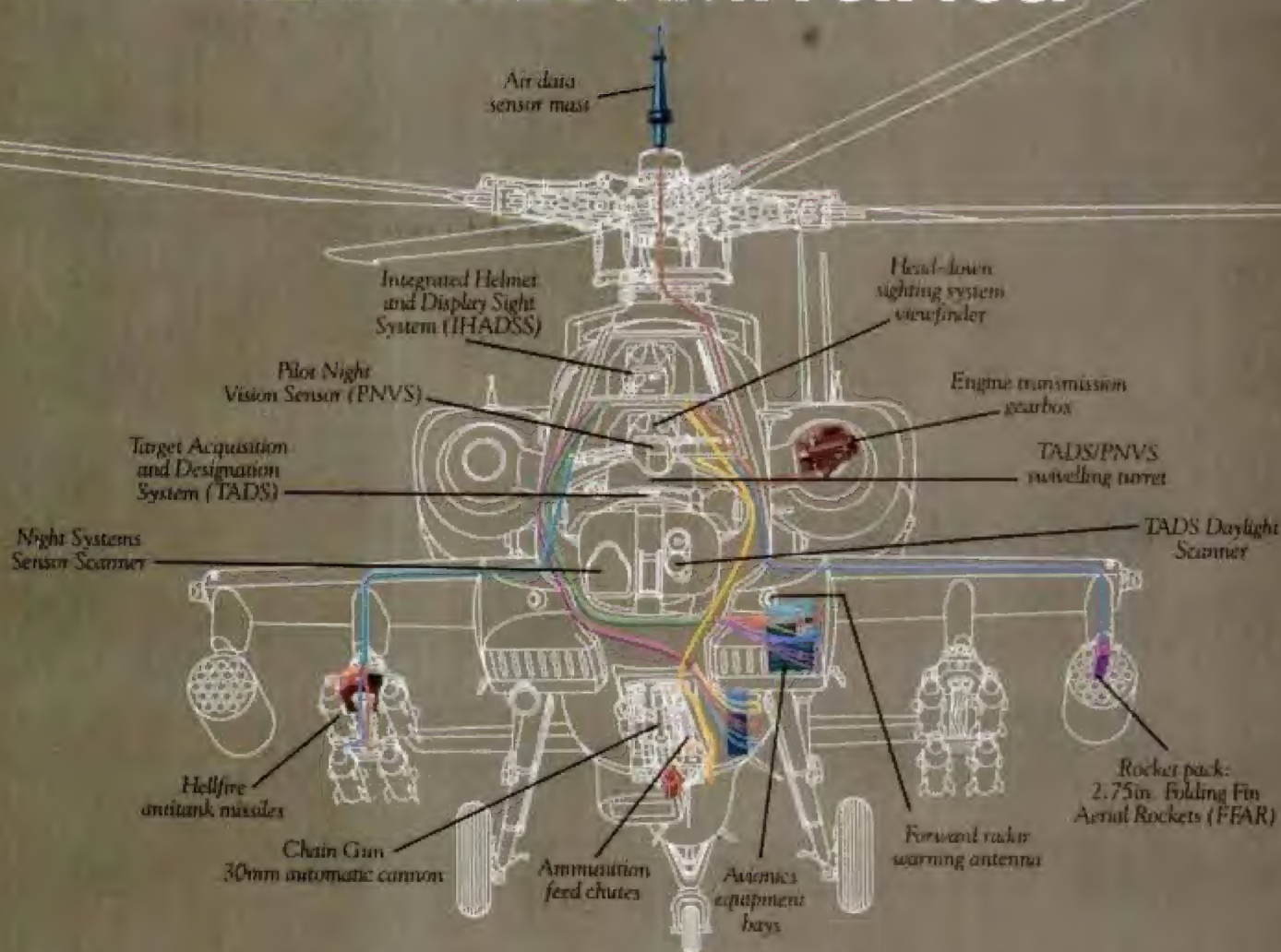
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HERE'S WHAT'S IN IT FOR YOU.



It can see in the dark. And attack without being seen. Rain or shine, it can strike like lightning. It's fast, mean, and smart.

But the Apache attack helicopter doesn't fly by itself. It needs trained experts to keep it at its most ferocious.

You can be one of those experts.

If you're interested in electronics, there's a lot inside an Apache to challenge you: Infrared night vision sensors.

Laser tracking and targeting technology. Avionics systems unequalled anywhere in the world.

The Army can train you to repair and maintain those systems—important skills that can help you get an edge on life.

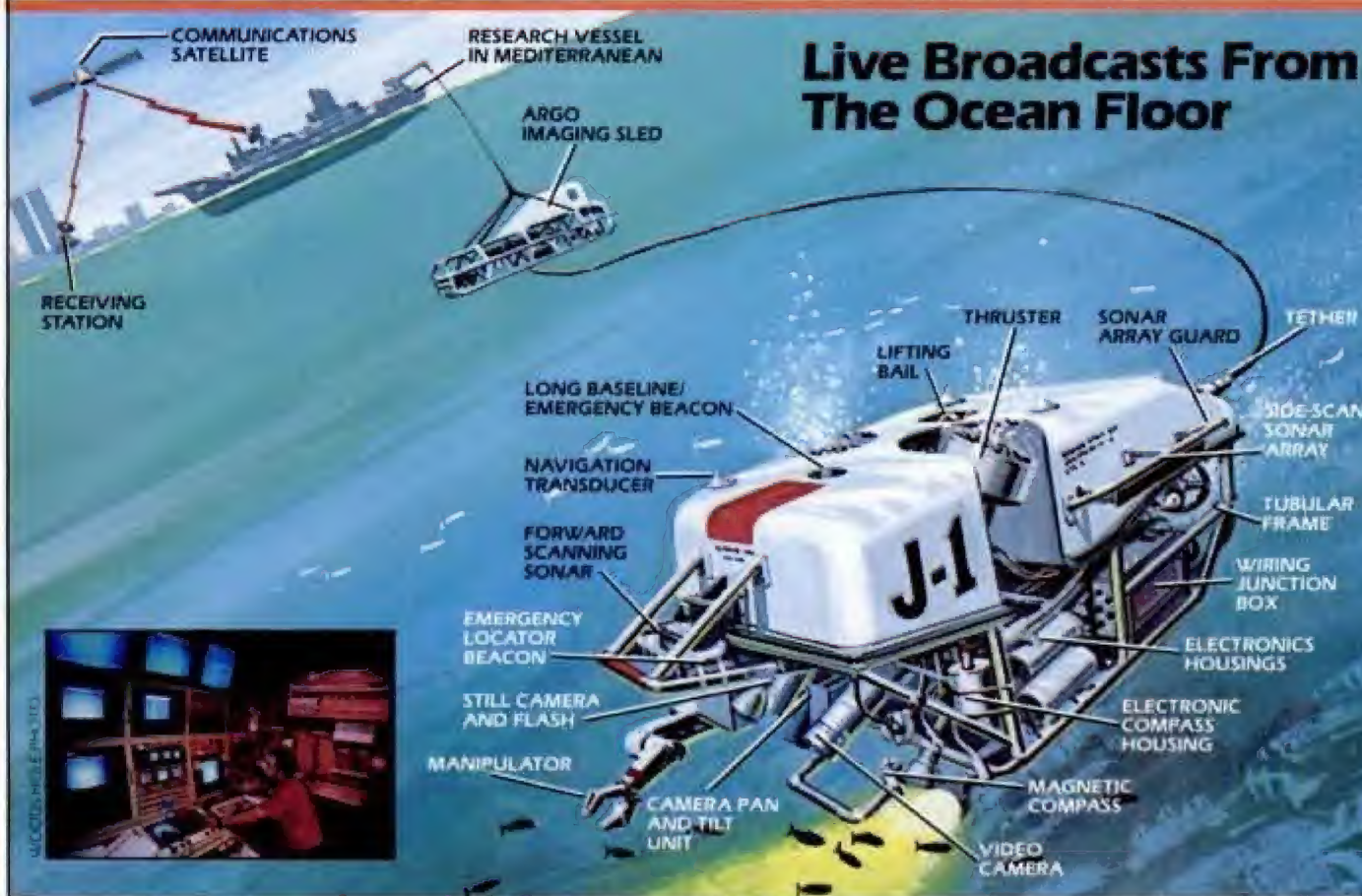
So talk to your Army recruiter. Or call 1-800-USA-ARMY. And find out how you can get under the skin of an Apache.

Once you've seen what's inside, you'll be glad it's on your side.

ARMY. BE ALL YOU CAN BE.

TECH UPDATE

News Of Tomorrow's Technology Today



Jason captures sea floor video images using special pan and tilt cameras operated by shipboard personnel (above left).

WOODS HOLE, MA—Following on his success as discoverer of the *Titanic*, Dr. Robert Ballard of the Woods Hole Oceanographic Institute is planning an undersea extravaganza next month that will transmit live video from underwater research sites in the Mediterranean. More than 150,000 students in the U.S. and Canada will become undersea explorers when the video images of volcanoes, hydrothermal vents and ancient shipwrecks are transmitted via satellite to participating science museums. (Call PM's Science/Technology hotline—212-265-7740—on Wednesdays from 3 to 5 p.m. for details.)

Question and answer periods with on-site researchers

are planned, creating immediate involvement with a major scientific research project through the miracle of live "telepresence."

Keys to the broadcasts are advanced technologies in robotics, photonics, TV satellite communication and computer science. The dual *Argo/Jason* underwater imaging system consists of the *Argo* sled, which incorporates precision dynamic positioning and side-scan sonar. *Argo* carries *Jason*—a development of *Jason Jr.* used to explore the *Titanic*. *Jason* uses panning/tilting video and still cameras.

Editor: Tim Cole
Assistant Editor: Ape Dami
Contributors: Mike Eilers
Tony Nassi, Jay Koblitz

Highlights This Month

- **Jet Jocks**—Lightweight, high-strength compressor blades change the way we fly.
- **Remote Air Traffic Control**—Establishing tactical forward air bases using miniature navigation beacons.
- **We're Outta Here**—New car keys dispenser speeds airport car rental.
- **Hoverbot**—Scanning future battlefields with a vertical lift recon device.
- **Medical Balloons**—Catheter angioplasty moves from the heart to the head.
- **What's Next With The Shuttle**—New experiments and hardware improvements in America's space transportation system.
- **The President's New Helicopter**—Updated communications and other niceties mark the chief executive's personal bird.

The challenge was to create a new car worthy of wearing the Thunderbird wings. The result is the most aerodynamic Thunderbird ever. And a car with performance to match its looks.

A responsive 3.8 liter V-6 engine with sequential electronic fuel-injection is standard. So is an independent rear suspension. And there's even the option of four-wheel-disc anti-lock brakes.

Inside, Thunderbird achieves a new level of comfort and convenience with increased room for five adults and a long list of standard features, including air conditioning, power windows and an electronic AM/FM stereo.

It all adds up to an automobile that's impressive

even by Thunderbird standards. The 1989 Ford Thunderbird.

Transferable 6-Year/60,000-Mile Powertrain Warranty.

Covers you and future owners, with no transfer cost, on major powertrain components for 6 years/60,000 miles. Restrictions and deductible apply. Ask to see this limited warranty at your Ford Dealer.

New Ford Thunderbird

**There's never been a car like Thunderbird.
And there's never been a Thunderbird like this.**



Buckle up—together we can save lives.

Have you driven a Ford...lately?



ROLLS-ROYCE PHOTO

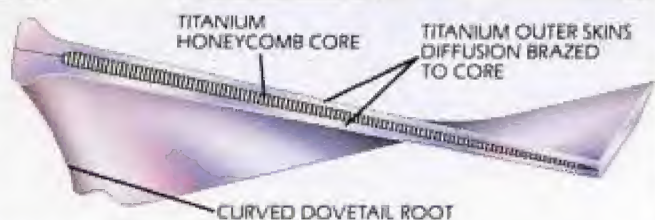
PM ILLUSTRATION BY MARIO SERRO



Jet Fan Blades Reshaped

DERBY, ENGLAND—Fuel efficiency, the holy grail of aircraft engine design, has taken a significant leap forward with the wide-chord fan design in the Rolls-Royce 535E4 aircraft powerplant. The innovation promotes greater fan efficiency and, hence, a 4-percent reduction in fuel consumption at maximum cruise. Wider fan blades control vibration. Fewer fans are used, reducing weight. The key: A new composite sandwich of titanium honeycomb.

Wide-chord fan blades on the Rolls-Royce 535E4 aircraft engine create new efficiencies.



Miniature PTAG means troops can be safely ferried to front lines without air drop risk.

with military air drops. The Air Force is developing a Portable Tactical Approach Guidance (PTAG) device that will allow Military Air-lift Command C-130s to make precision landings on remote unimproved jungle or desert strips in half-mile visibility.

Set up in appropriate areas by air-dropped combat teams, the unit consists of a localizer ground station that provides lateral orientation and glideslope to an incoming pilot. Lithium batteries power the ground station, which processes signals through a special instrument landing system (ILS) converter. Pilots receive cockpit information identical to that of a conventional ILS as they guide infantry- or cargo-laden aircraft in for a landing. Chief user will be Special Forces units.

Tactical Nav Beacon

DAYTON, OHIO—Advanced miniature electronics are on the cutting edge of an effort to reduce the danger and breakage associated

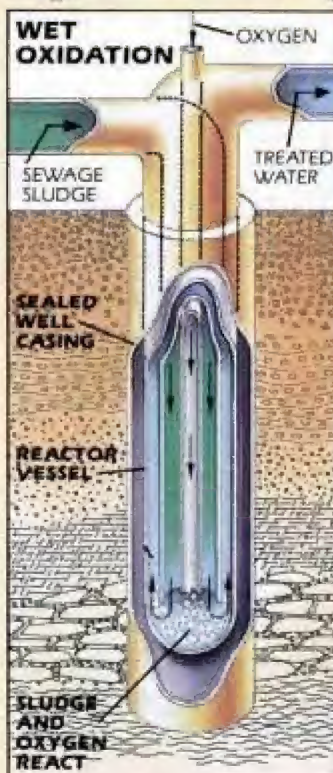
High-Tech Help In The Fight To End Pollution

NEW YORK, NEW YORK—Some intriguing new weapons have entered the struggle to protect our environment.

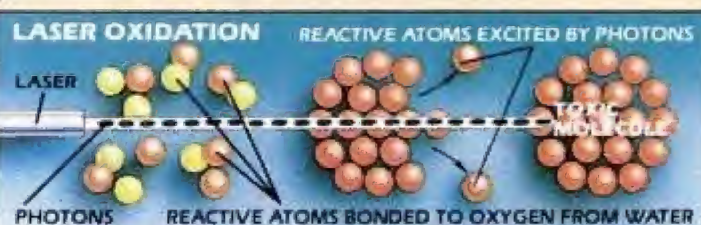
A wet oxidation process converts sewage sludge into clean water and sterile ash. The sewage undergoes this conversion when it is combined with oxygen under high pressure at the bottom of a 5000-ft. well casing.

Elsewhere: The intermolecular bond of a toxic substance can be broken using high-intensity photons in a laser oxidation process that takes place in a photochemical reaction chamber. Following the laser treatment, oxygen injection renders pollutants harmless.

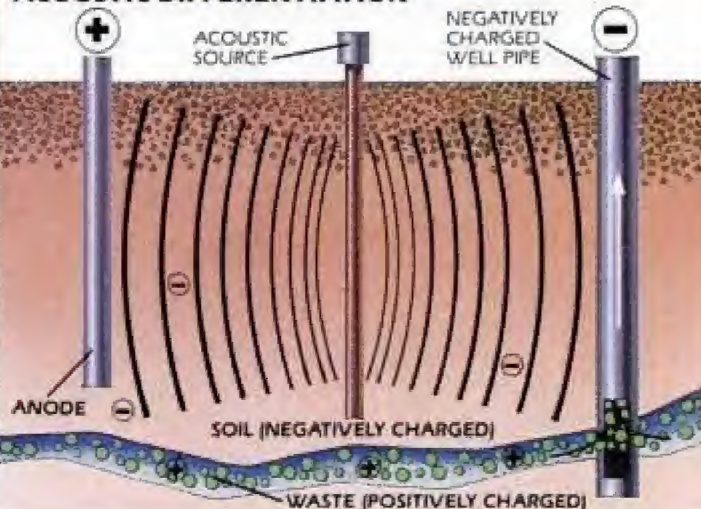
Also: Low-frequency soundwaves and electric charges are being used by researchers at Batelle Memorial Laboratories to coax pollutants out of soils. After a positively charged anode is introduced to the ground, positively charged water and contaminants migrate toward



a negatively charged withdrawal well acting as a cathode. The process speeds up when a sound source helps break the linkage between



ACOUSTIC DIFFERENTIATION



toxic compounds and surrounding soil.

These EPA-funded projects may begin correcting our wasteful ways.

Three proposals for eliminating waste: Sewage is pumped to bottom of 5000-ft. well (left). Laser (top) breaks up toxin. Acoustic source (above) separates soil from pollutants.



Airport car rental transactions simplified.

Special Car Key Dispenser

MINNEAPOLIS, MN—Automation continues to change a nation's travel habits. The National Car Rental "Smart Key" machine gives customers their keys after a "Privilege Preferred" card is passed through a swipe. The card's magnetic strip contains personal data. Renters show their driver's license to a gate attendant to complete the transaction.

Unmanned Hoverbot For Forward Troops

LIVERMORE, CA—Department of Defense policy on remotely piloted vehicles (ROVs) is still being formulated. But engineers at Sandia National Laboratory have come up with an ROV that addresses a need that has so far remained unmet.

Troops at the forward edge of battle need a simple aerial reconnaissance device that looks over the next hill—not necessarily into the next county. The AROD, which stands for Airborne Remotely Operated Device, weighs only 85 pounds fully



The tiny Sandia AROD scans battle space at close-in ranges. Ground controllers (left) operate the device with transportable hand unit.



fueled, making it transportable for small combat teams. A tiny 2-way fiberoptic cable receives direction changes from a ground controller and sends back high-quality video images. While the fiberoptic link avoids enemy jamming, it also limits range. A

free-flying version might be used as a shipboard mine spotter.

Powering the ROV is a 26 hp 2-cylinder 2-stroke engine, which also generates onboard electricity for stabilizing sensors and control vanes.

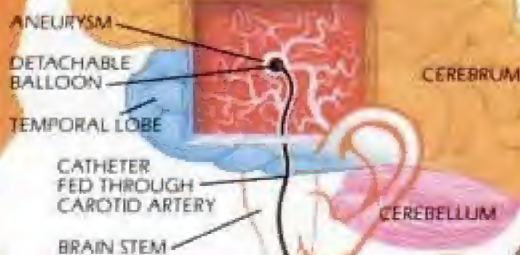
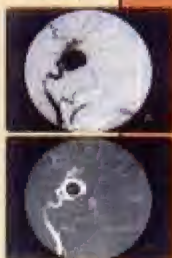
Balloon Angioplasty Finds Other Applications

SAN FRANCISCO, CA—Balloon catheter techniques developed to open clogged coronary arteries are finding their way into other medical procedures. The goal is similar in every case: to avoid highly dangerous invasive surgery using miniaturized systems and highly sophisticated imaging capabilities.

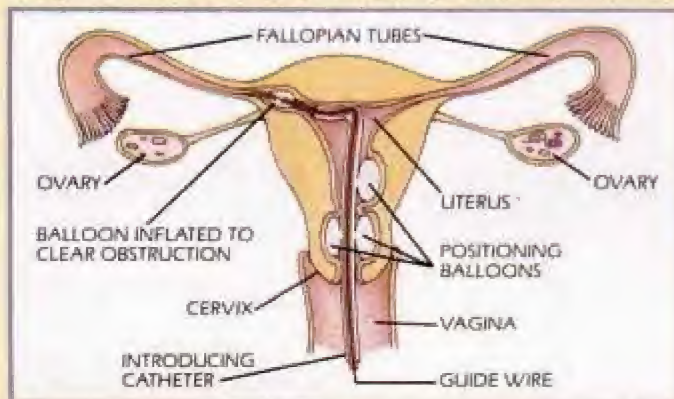
At UC-San Francisco, Dr. Randall T. Higashida and his team are using transluminal angioplasty to open constricted vessels in the brain in an effort to circumvent complex, dangerous neurosurgery.

The condition, called intracranial vasospasms, is a common complication of brain hemorrhages that afflict 40 to 50,000 Americans every year—often as a result of bursting aneurysms.

The tiny silicone balloon at the tip of a hair-thin catheter is guided through an artery in the groin to the implantation site using special fluoroscopic imaging equipment that deletes everything from the picture but



Fluoroscopic imagery of a brain aneurysm (above left) shows before and after intervention with balloon, involving carotid artery (above). At left, a transcervical tuboplasty.



the balloon and blood vessels. One fluoroscopic device, the OEC-Diasonic Series 9000, can store up to 60 images and contains advanced digital imaging features. In some cases, the balloon technique can be used to plug aneurysms outright in a technique called embolotherapy, which was pioneered by doctors in the

Soviet Union.

In a gynecological setting, balloon catheters are being used to unblock fallopian tubes in a transcervical balloon tuboplasty procedure. The out-patient operation is performed under local anesthesia, avoiding the pain and prolonged recuperation of microsurgery.

**The Best Reason
For Buying A
Procraft Boat Isn't
The Boat Alone.**

It's The Power Be



And what exactly is this power we're talking about? Simply put, it's the power of all the people involved in developing our new line of Procraft® fishing rigs.

You see, before we even thought about putting a boat together, we talked to the leading experts in the marine industry, including professional fishermen, award-winning marine designers and some of the hottest marine engineers in the country.

We also talked to thousands of people like you, from serious fishermen to people who are just getting on the water for the first time.

As a result, we found out what you're looking for—great boats at great prices, brought to you with as little hassle as possible.

This is the power we've tapped. And this is the power that has led to Procraft, a line of complete boating rigs like nobody has ever seen before.

WE'VE DONE ALL THE HOMEWORK FOR YOU.

If you've thought about buying a boat, chances are there are two concerns that have kept you from buying it. One, the cost. And two, the hassle of matching it with the right

engine, with the right trailer, with all the right equipment you need.

Well, that's where our experts came in. You see, we challenged them to answer all those concerns for you. And the results?

A line of top quality boat packages that fit a broad range of needs—and budgets. So regardless of why you want a powerboat, we've got the right boat for you at low monthly prices.

INSTANT BOATING. JUST ADD WATER.

Now, which one of our boats is right for you?

Well, if you're a real trophy

hunter and need to move quickly from hot spot to hot spot, check out our line of high performance Stalker™ Tourney™ and Procaster™ fiberglass bass boats.

If you're a fisherman who wants to get to those hot spots quickly, but also wants something the family can ski behind, our fiberglass Family Fisher™ series let you troll in the morning and ski that afternoon.

If you're looking for an aluminum boat that's sturdy, reliable and great for weekend fishing trips to the cabin, we've got everything from our Outdoorsman™ series to our deluxe Bass and Crappie Hunters™ series, with prices starting as low as \$95⁰⁰/month.*

And finally, if you just want to float down the river, bask in the sun, barbecue with the family and maybe do a little fishing, you should be in one of our Funchaser™, Fishchaser™ or Voyager™ pontoon boats. Prices start as low as \$101⁰⁰/month.*

But regardless of which boat package is right for you, you'll find more features than any similar competitive model. Just shop around and see for yourself.

We also custom-match all our boats with Mariner® outboards—



hind It.



the perfect outboards for fishermen who demand both performance and proven reliability.

But our efforts don't stop here. You see, beyond just offering complete boat packages with quality components, our fishing experts have designed and thoroughly tested every component and accessory to work together as a unit.

So all you have to do is decide which package is for you, then hitch it up to your car and go.

**WE COVER EVERYTHING FROM
STEM TO STERN.**



*Based on Manufacturer's Suggested Retail Price of \$6,560.00 (Crippie Hunter 16.75) and \$8,980.00 (Fishmaster 20), with approved credit at participating MMAC financing dealers. Payments based upon down payment of 20% (cash or trade-in) plus taxes, license and fees. 12-99% APR. Procraft dealer can provide additional details. Term is 84 months.

And to prove to you that none of this is just talk, we back every Procraft rig with our Procraft Stem-to-Stern™ limited warranty, the most comprehensive warranty in the business. It covers virtually every part on every boat, motor, trailer and accessory we sell. And includes a Mariner outboard 3-year limited warranty against corrosion with an optional 2-year extended Product Protection Plan.

So, if you do have a problem, your dealer will take care of it and get you back on the water quickly and without hassle.

**DEALERS WHO ARE PREPARED TO
SATISFY YOUR EVERY BOATING NEED.**

But beyond just making it easy for you to get on the water, we've also made it easy for you to stay on the water with a customer care program that gives you quick, professional, courteous service.

You see, unlike a lot of repair shops out there, every Procraft dealership is staffed with certified mechanics and technicians — people who've undergone extensive training covering virtually every aspect of boat repair.

They also use state-of-the-art diagnostic and repair equipment.

They offer quick on-the-spot financing. And once you've bought a boat, they will even tell you everything you need to know about maintaining it and running it safely.

In short, we'll do anything and everything we can to keep you and your boat happy. Including giving it a thorough inspection before you buy it to make sure it's as water-ready as we designed it to be.

So, if you've been holding out for the day when boating will be easy and affordable, that day has finally arrived.

Take a look at the next few pages to find the boat that's right for you. Discover why, feature for feature, nobody can give you a better value than we can. For complete product information and the name of your nearest Procraft dealer, call:

1-800-526-6630

PROcraft
powered by Mariner

To A Bass Fisherman, This Is Hawg Heaven.



Procraft Performance Bass Series

If you're a fisherman looking for a fishing machine that can get you quickly from hot spot to hot spot, select from one of our deluxe fiberglass bass packages. Each one includes everything fishermen demand, plus these *exclusive* features:

- Quicksilver™ stainless steel propeller
- Procraft Stem-to-Stern limited warranty

Feature for feature, nobody gives you a better value than Procraft. Shop around and you'll see for yourself. For complete product information and the name of your nearest Procraft dealer, call:

1-800-526-6630

	Model	Length	Beam	Mariner Engine	Boat Weight
Single Console Models	Stalker 150	15'5"	76"	60 HP	825 lbs.
	Stalker 160	16'4"	80"	75 HP	1050 lbs.
	Stalker 160	16'4"	80"	100 HP	1050 lbs.
	Stalker 170	16'10"	82"	90 HP	1100 lbs.
	Stalker 170	16'10"	82"	115 HP	1100 lbs.
	Stalker 180	18'	86"	115 HP	1200 lbs.
	Stalker 180	18'	86"	150 Mag II	1200 lbs.
	Stalker 190	19'10"	88"	150 Mag II	1550 lbs.
	Stalker 190	19'10"	88"	200 HP	1550 lbs.
Dual Console Models	Tourney 180	18'	86"	150 Mag II	1200 lbs.
	Tourney 190	19'10"	88"	150 Mag II	1550 lbs.
	Procaster 180	18'	86"	150 Mag II	1300 lbs.
	Procaster 190	19'10"	88"	150 Mag II	1650 lbs.
	Procaster 190	19'10"	88"	200 HP	1650 lbs.

*Based on Manufacturer's Suggested Retail Price of \$8,790.00, with approved credit at participating MMAC financing dealers. Payment based upon down payment of 20% (cash or trade-in) plus taxes, license and fees, 12.99% APR. Procraft dealer can provide additional details. Term is 84 months. We reserve the right to change prices and specifications without notice. Photos may include optional equipment.

If You Can't Decide Between A Fishing Boat Or A Ski Boat, Get Them Both.



Family Fisher™ 190

AS LOW AS
\$152⁶²
Per Month*
Family Fisher Series



Family Fisher™ 160

Procraft Fish & Ski Series

If you're looking for a fishing boat and a ski boat, choose from one of our versatile fiberglass fish & ski packages that let you fish in the morning and ski that afternoon. Each one is fully equipped and ready to go, and includes these exclusive features:

- Quicksilver™ stainless steel propeller
- Procraft Stem-to-Stern limited warranty

Shop and compare. You'll soon see, feature for feature, nobody gives you what we can give you. For complete product information and the name of your nearest Procraft dealer, call:

1-800-526-6630

Model	Length	Beam	Mariner Engine	Boat Weight
Family Fisher 160	16'4"	80"	75 HP	1050 lbs.
Family Fisher 170	16'10"	82"	115 HP	1100 lbs.
Family Fisher 180	18'	86"	115 HP	1220 lbs.
Family Fisher 180	18'	86"	150 HP	1220 lbs.
Family Fisher 190	19'10"	88"	150 HP	1550 lbs.

*Based on Manufacturer's Suggested Retail Price of \$90,490.00, with approved credit at participating MMAC financing dealers. Payment based upon down payment of 20% (cash or trade) plus taxes, license and fees, 12.99% APR. Procraft dealer can provide additional details. Term is 84 months. We reserve the right to change prices and specifications without notice. Photos may include optional equipment.

Try One Of Our Fishing Boats And You'll Be Hooked For Life.



Crappie[™] 160

Trailer: Procraft custom-built color coordinated, drive-on style trailer with 14" mag wheels with bearing protection, tongue jack, roller side guides and submersible lights

As Low As
\$95⁴⁴
Per Month*
Crappie Series



Crappie Hunter[™] 1560

	Model	Length	Beam	Mariner Engine	Boat Weight
Aluminum	Crappie Hunter 1560	15'	60"	25 HP	395 lbs.
	Crappie Hunter 1673	16'	73"	25 HP	540 lbs.
	Crappie Hunter 1673	16'	73"	40 HP	540 lbs.
Fiberglass	Crappie [™] 150	15'5"	76"	40 HP	825 lbs.
	Crappie [™] 160	16'4"	80"	60 HP	1050 lbs.

*Based on Manufacturer's Suggested Retail Price of \$6,560.00, with approved credit at participating MMAC financing dealers. Payment based upon down payment of 20% (cash or trade) plus taxes, license and fees, 12.99% APR. Procraft dealer can provide additional details. Term is 64 months. We reserve the right to change prices and specifications without notice. Photos may include optional equipment.

Procraft Crappie Fishing Series

It's everything you want in a fishing boat. Performance. Reliability. And loaded with all the features serious fishermen demand in their rigs, including these *exclusive* Procraft features:

- Quicksilver[™] stainless steel propeller
- Procraft Stem-to-Stern limited warranty

In fact, they've got it all. Just shop around and compare for yourself. You'll soon see that, feature for feature, nobody gives you more for your money than we do.

For complete product information and the name of your nearest Procraft dealer, call:

1-800-526-6630

This Could Be The Beginning Of A Great Fish Story.



Procraft Aluminum Fishing Series

If you really want to catch those lunkers, our Bass Hunter™ is for you. It's quick. Tough. And loaded with everything you could ever want in a fishing boat, including this exclusive feature:

- Procraft Stem-to-Stern limited warranty

Or if you need a smaller, versatile boat, select one of our Outdoorsman models. Nobody gives you more features for your money than we do. Just shop around and compare for yourself.

For complete product information and the name of your nearest Procraft dealer, call:

1-800-526-6630

Model	Length	Beam	Mariner Engine	Boat Weight
Bass Hunter 1673	16'	73"	25 HP	555 lbs.
Bass Hunter 1673	16'	73"	40 HP	555 lbs.
Bass Hunter 1773	17'	73"	40 HP	700 lbs.
Bass Hunter 1773	17'	73"	60 HP	700 lbs.
Bass Hunter 1773 Pro-Deck	17'	73"	40 HP	745 lbs.
Bass Hunter 1773 Pro-Deck	17'	73"	60 HP	745 lbs.
Bass Hunter 1773 Pro-Deck	17'	73"	75 HP	745 lbs.
Outdoorsman 1456	14'	56"	4 HP	200 lbs.
Outdoorsman 1456	14'	56"	15 HP	200 lbs.
Outdoorsman 1667	16'	67"	8 HP	295 lbs.
Outdoorsman 1667	16'	67"	20 HP	295 lbs.
Outdoorsman 1573	15'6"	73"	30 HP	300 lbs.
Outdoorsman 1573	15'6"	73"	25 HP	300 lbs.

*Based on Manufacturer's Suggested Retail Price of \$6,990.00, with approved credit at participating MMAC financing dealers. Payment based upon down payment of 20% (cash or trade) plus taxes, license and fees. 12.99% APR. Procraft dealer can provide additional details. Term is 84 months. We reserve the right to change prices and specifications without notice. Photos may include optional equipment.

Now You Can Afford To Take That Long Summer Cruise.



Model	Length	Beam	Mariner Engine	Boat Weight**
Fishchaser 20	20'	8'	25 HP	1100 lbs.
Fishchaser 20	20'	8'	40 HP	1100 lbs.
Funchaser 20 LE	20'	8'	25 HP	1100 lbs.
Funchaser 20 LE	20'	8'	40 HP	1100 lbs.
Funchaser 24	24'	8'	25 HP	1700 lbs.
Funchaser 24	24'	8'	50 HP	1700 lbs.
Funchaser 24 LE	24'	8'	40 HP	1700 lbs.
Funchaser 24 LE	24'	8'	75 HP	1700 lbs.
Funchaser 28 LE	28'	8'	40 HP	2310 lbs.
Funchaser 28 LE	28'	8'	75 HP	2310 lbs.
Voyager 28	28'	8'	90 HP	3200 lbs.

*Based on Manufacturer's Suggested Retail Price of \$6,980.00, with approved credit at participating MMAC financing dealers. Payment based upon down payment of 20% (cash or trade) plus taxes, license and fees, 12.99% APR. Procraft dealer can provide additional details. Term is 84 months. We reserve the right to change prices and specifications without notice. Photos may include optional equipment.

**Boat weight only.

Procraft Pontoon Series

If you just want to do a little floating, bask in the sun, barbecue with the family and maybe do a little fishing, this is the perfect rig for you. Each pontoon boat is fully equipped with everything you need for fun on the water, including these *exclusive* features:

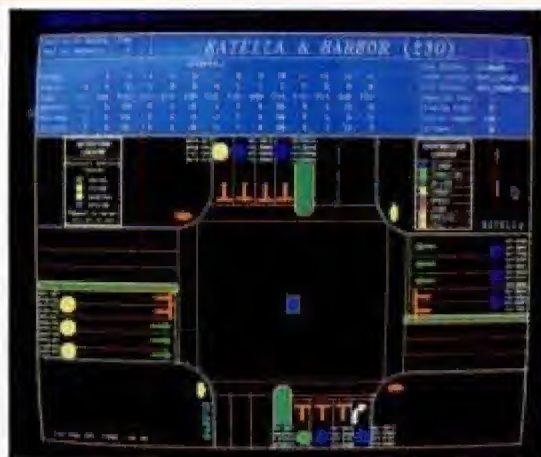
- Pressure-treated tongue & groove marine grade wood floor with plush marine grade carpeting
- Procraft Stem-to-Stern limited warranty

Feature for feature, nobody gives you more for your money than Procraft. Compare our features to other packages and see for yourself.

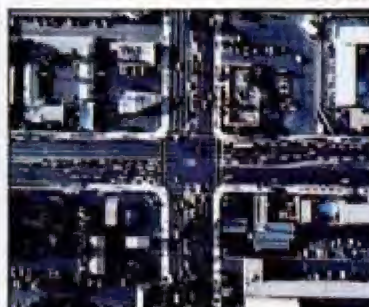
For complete product information and the name of your nearest Procraft dealer, call:

1-800-526-6630

CITY OF ANAHEIM PHOTOS



CONF ON WOMEN
HOTEL LOT FULL
USE CONV CTR



Computer graphic (left) shows detail of intersection in photograph (right). Message on sign (above right) advises drivers of situation ahead.

Traffic Computers

ANAHEIM, CA—To optimize traffic flow under constantly shifting conditions, engineers are installing the country's most extensive computerized traffic control network. It will coordinate the operation of 250 traffic signals, and 12 changeable fiberoptically lit message signs. Pavement sensors feed vehicle speed and frequency data to computers in a central control center, producing color graphic displays that can zoom from a full city map to a closeup of one intersection. Controllers respond by adjusting signal timing, and sign messages. Key intersections can be viewed through color video cameras that pan and zoom by remote control.

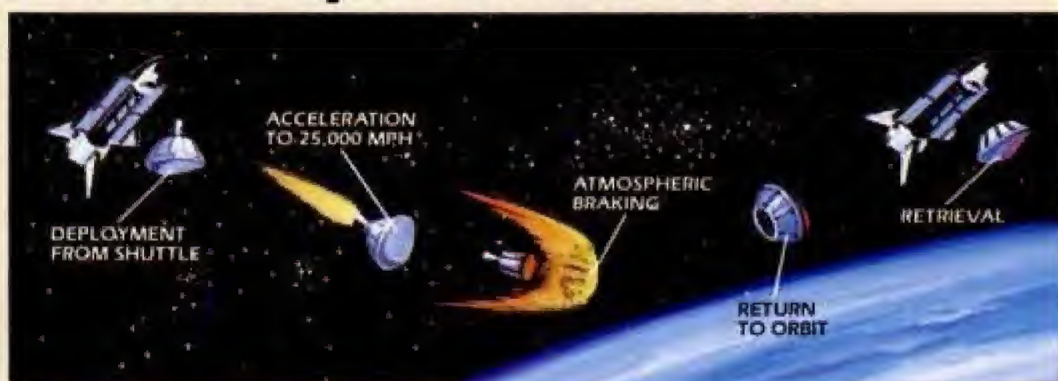
Shuttle Update: New Experiments, Orbiter

NEW YORK, NY—The early 1990s will bring the completion of a replacement for *Challenger*, and experiments that will rehearse complex choreography between the Shuttle and other vehicles.

Temporarily dubbed OV-105, the new orbiter is in initial assembly at Rockwell International's Palmdale facility. OV-105 will incorporate all improvements added to the other three Shuttles since the *Challenger* disaster.

In August, 1993, OV-105 will deploy a vehicle designed to test the use of atmospheric braking.

Aerobrake technology could be used in reusable spacecraft called aero-as-



Aerobrake vehicle tests atmospheric deceleration.

sisted orbital transfer vehicles (AOTVs), which would ferry payloads between the Space Station and higher orbits. Avoiding the need for fuel-hungry retrorockets would enable AOTVs to

carry heavier payloads.

In the shorter term, another multivehicle experiment, called *Starbird/Starlab*, will test basic SDI technology. *Starlab* consists of a laser-equipped spacelab module

scheduled to fly aboard *Columbia* Sept. 10, 1990. *Starlab* will use passive detectors to track a modified sounding rocket called *Starbird* after it is launched toward *Columbia*. As *Starbird* approaches, *Starlab* will lock on with a laser illuminator, then fire a sharply focused laser designator at a detector aboard *Starbird*.



Starlab fires designator beam at *Starbird* target (left). Air-bearing-equipped tooling helps mate OV-105 wing with mid fuselage.

PM ILLUSTRATIONS BY ED VALIGURSKY

Presidential Choppers Updated

QUANTICO, VA—Nine new Sikorsky VH-60s have joined Marine Helicopter Squadron One (HMX-1), the outfit responsible for flying the President and other White House officials. They replace VH-1Ns—executive versions of the Huey—that have been in service with HMX-1 since the mid '70s.

Based on the Army's UH-60A Black Hawk utility helicopter, the VH-60 is distinguished by a high durability gearbox and upgraded



Sikorsky VH-60 sports presidential "white-top" colors.

avionics. The soundproofed VIP cabin has a radio operator's station, and hardened electronics to withstand interference. Instant worldwide communications and executive comfort combine in

a 10-place helicopter that will see service primarily in Washington, D.C., and environs. However, the VH-60 is transportable aboard C-141 and C-5B aircraft, which means the VH-60 can accom-

pany the president worldwide. HMX-1 will still use the larger VH-3Ds for many missions. But the VH-60s' expanded communications capabilities will make them an important adjunct.

Reliable High Tech For Future Battlefield

NEW YORK, NY—What works in the lab may not work in the battlefield, so developers of high-tech weapons rely on real combat lessons.

In developing the G11 Advanced Combat Rifle (ACR), Heckler & Koch has used data showing soldiers' marksmanship declines drastically in combat.

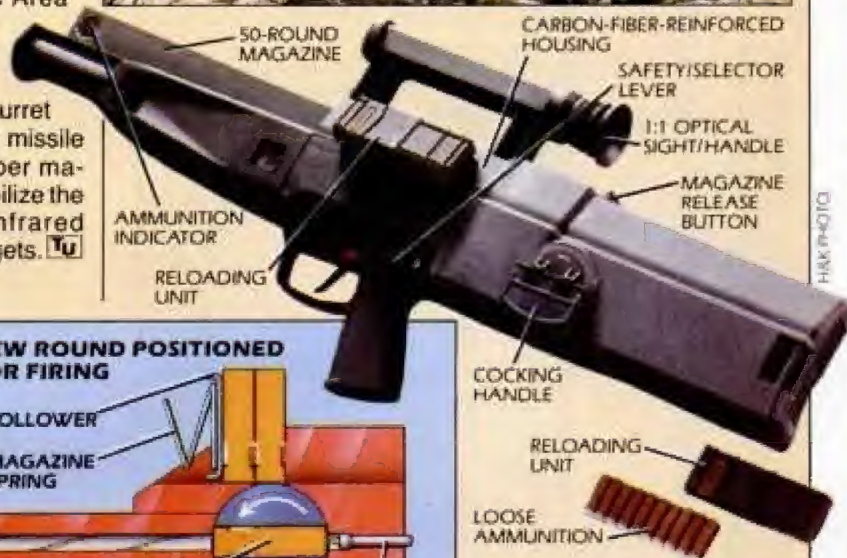
Their solution is a gun designed to fire small-caliber ammunition in high-speed 3-round bursts. Key to the system is caseless ammo—a bullet embedded in a shaped propellant charge. When fired, all but the bullet combusts, leaving the chamber empty to receive another round. This allows for a 2000 round-per-minute rate of fire. Caseless ammo also weighs about half as much as

standard NATO rounds.

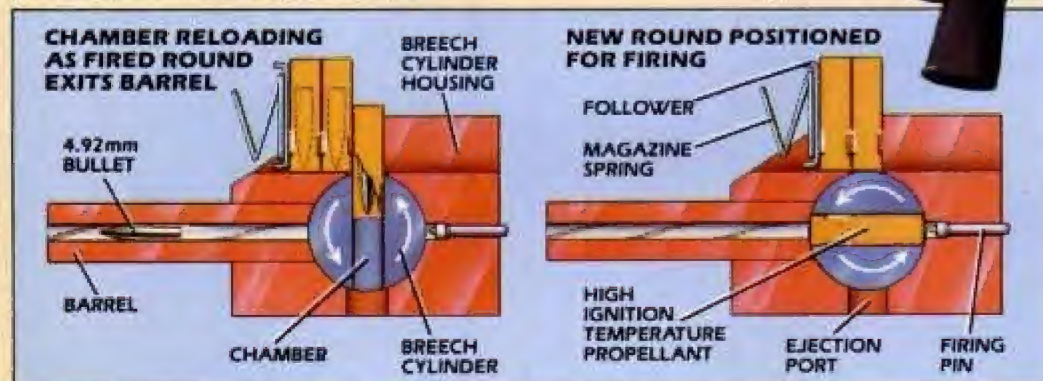
To prevent recoil from distorting the burst pattern, the entire barrel, breech and magazine assembly slide back into the stock on hydraulically damped springs. No kick is felt until the last shot is out the barrel.

For all-terrain anti-aircraft defense, Boeing has fitted the combat-proven stinger missile to a Hum-Vee, resulting in the Pedestal Mounted Stinger/Avenger, part of the Army's new forward Area Air Defense (FAAD) System.

A lightweight, graphite composite turret carries two 4-Stinger missile pods and a .50-caliber machine gun. Gyros stabilize the turret and a laser infrared sensor helps pick targets. **[U]**



FEED AND FIRING MECHANISM



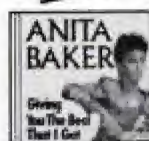
H&K G11 rifle uses a cylindrical drum breech to achieve high rates of fire (left). All working parts are sealed in a watertight housing (above).

The ultimate in sound...
The ultimate in savings...

GET 6 COMPACT DISCS

FOR THE PRICE OF 1

...with nothing more to buy ever!



100586

100715. R.E.M.: Green Orange Crush, Pop Song 89, etc. (Warner Bros.)

100602. Elton John: Reg Strikes Back • Elton's 22nd gold album! (MCA)

264134. D.J. Jazzy Jeff & The Fresh Prince: He's The D.J., I'm The Rapper (Jive)



200596

200478. Metallica: And Justice For All • #1 Speed metal band! (Elektra)

223559. The Beach Boys: Endless Summer • 21 timeless hits! (Capitol)

100532. Diane Schuur: Talkin' 'Bout You • Cry Me A River, etc. (GRP)



100711

154135. The Best Of Steely Dan: Decade 14 hits. (MCA)

104871. Supertramp: Classics (14 Greatest Hits) • The Logical Song, Give A Little Bit, more. (A&M)

144578. The Judds: Greatest Hits • (RCA)

115356. Pinocchio: Vivaldi, The 4 Seasons • Simon Standage, violin; etc. (Archiv DIGITAL)

114780. Cinderella: Long Cold Winter • Gypsy Road, Don't Know What You Got, more. (Mercury)

134347. Huey Lewis: Small World • (Chrysalis)

173406. Jazz CD Sampler Over 67 minutes of jazz. (Polygram)

100467. Beethoven, Symphony No. 9 (Choral) London Classical Players/Harrington. (Angel DIGITAL)

123721. Jimmy Page: Outrider • Led Zeppelin guitarist's solo flight! (Geffen)

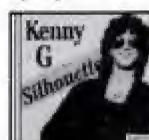
134321. Led Zeppelin: Houses Of The Holy (Atlantic)

153606. INXS: Kick • Need You Tonight, Devil Inside, etc. (Atlantic)

100517. Phil Collins: Buster/Soundtrack • Groovy Kind of Love, Two Hearts, etc. (Atlantic)

134420. John Cougar Mellencamp: The Lonesome Jubilee • Paper In Fire, more. (Mercury)

100008. Randy Travis: Old 8x10 • Honky Tonk Moon, more. (Warner Bros.)



100603

105392. Pops In Space John Williams & The Boston Pops. Music from Star Wars, The Empire Strikes Back, more. (Philips DIGITAL)

153582. Tracy Chapman: Fast Car, Talkin' 'Bout A Revolution, etc. (Elektra)

164165. Bobby McFerrin: Simple Pleasures • Don't Worry Be Happy, etc. (EMI)

244006. Simon & Garfunkel: The Concert In Central Park • All-time classics! (Warner Bros.)

125179. Tchaikovsky, 1812 Overture; Romeo And Juliet; Nutcracker Suite Chicago Symph. Orch./Solti. (London DIGITAL)

100459. Cocktail (Original Soundtrack) • (Elektra)



115436

100604. Heifetz: The Decca Masters, Vol. 1 Gollwog's Cakewalk, Clair de lune, many more. (MCA)

100035. Robert Palmer: Heavy Nova • Simply Irresistible, More Than Ever, etc. (EMI)

123385. The Best Of Eric Clapton: Time Pieces (Polydor)

100579. K. T. Oslin: This Woman • Hold Me, Money, title song, more. (RCA)

100470. Vangelis: Direct New Age Meditations, The Motion Of Stars, The Will Of The Wind, etc. (Arista)

153983. Charlie Parker: Compact Jazz • Now's The Time, Night And Day. (Verve)



100707



182522

270106. An Evening With Louis Armstrong • (GNP Crescendo)

262889. Virgil Fox: The Digital Fox • Organ music by Bach, others. (Bainbridge DIGITAL)



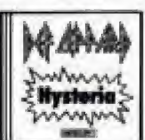
115311

209468. Perlman: Brahms, Violin Sonatas (Angel DIGITAL)

120768. 20 Great Love Songs Of The 50s & 60s, Vol. 1 • (Laurie)



170348



100927

153740. Genesis: Invisible Touch • (Atlantic)

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Inside Soviet Science And Technology

A boastful Soviet gentleman proclaims to his capitalist cousin: "Here in the USSR we make the biggest hydroelectric dams, the biggest airplanes, the biggest earth moving equipment—even the biggest microelectronics."

This self-deprecating oxymoron currently circulating in Moscow is a testament to the new breeze blowing in the Soviet Union. It also punctures the Western myth that Soviets live in a humorless vacuum.

But try that one on Oleg Pchelyakov, head of a Soviet microelectronics lab—as I did—and you get a sigh of resignation.

I visited Oleg and his colleagues at the Institute of Semiconductor Physics at the Novosibirsk Science Center while preparing "Red Tech Rising," (page 84). They are struggling to compete in the global race to create faster, smaller microchips.

Oleg showed me the USSR's state-of-the-art molecular beam epitaxy device—a machine used to fashion fragile semiconductor lattice



The upside: Power meets glory at Moscow's museum of space achievements.

structures using evaporation techniques, laser annealing and ion implantation. The apparatus was bolted to a concrete floor in the basement of the institute. Paint was peeling from the walls and there was no apparent effort to maintain an air-conditioned clean room. In an increasingly digitized world, the Soviets had failed to master one of the fundamentals in crafting semiconductors—only one reason why they lag in key technologies.

But don't take my word for it. High-ranking Soviet academicians themselves are using Mikhail Gorbachev's window of reawakening for a cathartic dose of self-criticism. The most blistering attack came last year from Roald Z. Sagdeev, former director of the Soviet Space Research Institute.

Sagdeev wrote in the scientific journal *Issues in Science and Technology*: "For too long, Soviet science has hidden its inadequacies be-

hind official panegyrics to its success. In academic and political forums alike, exaggerated claims have been made for the achievements of Soviet science. Science has its own criteria for success, however, and Soviet achievements have not measured up to them."

Harsh words from the guiding hand of the immensely successful Soviet space program. But his comments homed in like a rifle shot on the chief affliction of Soviet laboratory efforts: For too long, Soviet science and technology have been driven by political objectives.

Likewise, the quality control inherent in a market-driven economy would never permit the kind of slipshod semiconductor manufacturing demonstrated at the institute.

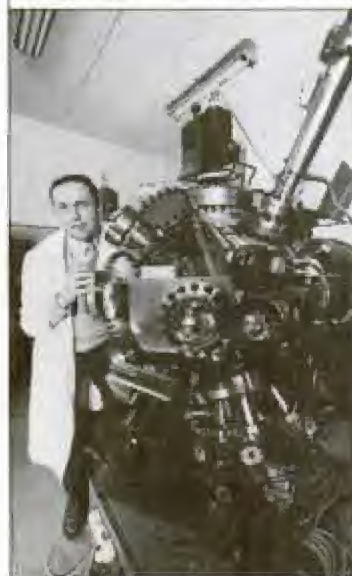
But there is an underlying paradox in the Soviet Union generally—and in Soviet science and technology efforts in particular. They do some

things very, very well. The Soviets have shown the West how to live in space, how to restructure massive bone deformities, how to work dissimilar metals with explosive welding methods. The lack of high-capacity computing power has "caused us to think a little harder," as one Moscow scientist told me chalk-in-hand, his blackboard filled with arcane equations.

Prospects are getting better. At Moscow's Lebedev Physics Institute, for instance, free and unfettered work continues on nonlinear optics of semiconductor lasers, gravitational fields, and the phase conjugation of laser emissions, among other compelling projects.

Indeed, despite current struggles, there are some bright spots emerging in Soviet science and technology—as Mikhail Gorbachev continues to unleash the power of the individual in Soviet society.

PM



The downside: A long way to go in semiconductors.

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More than 100 points separated Toyota's winning "4x4 of the Year" from second place. A landslide. Especially by 4Wheel & Off-Road magazine's exacting standards.

But that's hardly surprising. Since Toyota's all new 4x4 Xtracab SR5 V6 comes standard with a powerful, fuel-injected, 3.0-liter V6 and the new shift-on-the-move 4WDemand. And with the new forward-facing jump seats, it boasts an interior that according to the

magazine, "sets the standard for all other 4x4s." In short, the complete truck. The 4x4 of the Year.

No wonder it's the number-one-selling compact 4x4 in America.*

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IMPORTS

BY BILL HARTFORD

Hot Rides In Rear-Wheel Drive

IN THE movies, when they cut to the chase, you know you're going to see some really hot rear-wheel-drive cars in action. When it comes to laying down rubber and getting that tail hung out, rwd is the way to move.

It's simply physics, you know.

Off the line, weight transfer to the rear gets that car hunkered down on the driving wheels for the best bite on the road. Front drive wheels, on the other hand, become unloaded, lose their grip and start spinning and chattering much sooner. And wrestling with torque steer is no fun, either.

After driving too many space-efficient imports with front-wheel drive, it was fun, recently, to put some miles on a whole streak of '89s with rwd. Here's a look at three.

Beautiful Breadbox

First time out in one 150-hp model had me hot-shoeing around town as if I were in a sports car. With its 3.0-liter V6, this all-new Mazda really moves out. It is—of all things—the MPV, Mazda's 3500-pound, multipurpose van. It's impressive in every way, and with rwd and the optional V6, especially capable as a sporty, aerodynamic hauler ($C_d = 0.36$). Rear-wheel drive also let's you set up for towing—up to an im-



Mazda MPV: New multipurpose van that puts V6 power to the rear wheels and can tow 4300 pounds.

pressive 4300 pounds worth.

At roughly \$14,000, the MPV offers seats for seven, easy rear seat access through a hinged door (that we came to like better than the conventional sliding door) and styling that we consider the best yet in the breadbox-on-wheels category.

Stealth Sedan

If a plain-looking 4-door flashes past you so fast you miss the famous trident in the center of the grille, you'll still have a chance of catching the twin pipes and bold MASERATI badge on the trunk lid—if you're quick.

The 430 sports fine coachwork, to be sure, but the real action is under the hood and in the sumptuous interior. Twin turbos on the 2.8-liter V6 pump horsepower up to 225 at 5600 rpm. Top speed is

150 mph. We didn't come anywhere near testing this limit, but wish we owned a G-suit for our week of innumerable under-7-second 0-to-60-mph acceleration runs. This is a *fast* car, and driving it is a supremely tactile experi-

Giorgio Armani suit. A Braun clock. A Krups coffee-maker. A Porsche pipe. This modern-day musclecar is smooth and seamless, a liquid flow of pearlescent paint poured between body-colored bumpers.



Maserati 430: Rocketship of a sedan disguised as a vintage Datsun.

ence. Wood steering wheel and shift knob, plus other briarwood trim parts combine with leather and suede on the dash, seats and door panels, to create an automotive heaven. For \$43,000, the 430 offers you a practical 4-door configuration and an understated Q-ship appearance—with performance that's flashier than many low-slung exotics.

Designer Coupe

In dramatic contrast to the Maserati's styling is the shape of Nissan's all-new 240SX. This model is the automotive equivalent of a

The rear-wheel-drive work of art comes as SE Fastback and XE Coupe, which is the version we drove, and drove hard, taking all that the new 2.4-liter, 12-valve Four offered—140 hp and 152 lb.-ft. of torque. A 240SX is about \$14,000 to start, but you can option it out with a head-up mph display, CD player, antilock brakes and more.

In case you haven't been paying attention, Nissan is on a roll. Soon, you'll be seeing the new rear-wheel-drive 300ZX on the road, too—another model that's astoundingly beautiful in form and function.

PM



Nissan 240SX: Custom sports-car design with an off-the-rack price.

PM PHOTO BY MIKE ALLEN

PM PHOTO BY BILL HARTFORD



Traffic radar doesn't say which car is being clocked, it merely flashes a number. The radar operator must then try to determine which vehicle produced the reading.

Why radar makes mistakes. How to protect yourself.

Although nine different errors have been documented for traffic radar, the most common source of wrongful tickets is mistaken identity.

It's hard to believe, but traffic radar does not identify which vehicle is responsible for the speed being displayed. It shows only a speed number and nothing else. The radar operator must decide who is to blame.

How radar works

The radar gun is aimed at traffic and it transmits a beam of invisible radar waves. Each moving object within range reflects these invisible waves back to the radar gun. Using the Doppler principle, the radar calculates speed from the reflected waves.

Traffic radar is blind

Traffic radar works differently from military, air-traffic-control, and weather radars. The others use rotating dish antennas in order to track many objects simultaneously.

Traffic radar uses a far smaller, far cheaper, gun-shaped antennas. This simplification requires traffic radar to ignore all reflections but the strongest. The number displayed is speed calculated from the strongest reflection.

The best guess

Remember, these reflections are invisible. Truck reflections can be ten times stronger than car reflections. How can the operator know for sure which vehicle is responsible for the number?

The truth is, he can't be sure in many cases. The result is mistaken identity. You can be ticketed for somebody else's reflection.

Self defense

The only way to defend yourself against these wrongful tickets is to know when radar is operating near you. Others agree with this method. In his verdict upholding a citizen's right to use a radar detector, Judge Joseph Ryan, Superior Court, District of Columbia, wrote:

"If government seeks to use clandestine and furtive methods to monitor citizen actions, it can ill afford to complain should the citizen insist on a method to effect his right to know he is under such surveillance."

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We specialize in radar warning. And Escort and Passport do far more than simply find radar. Upon radar contact, the alert lamp responds and the meter shows radar signal strength. At the same time, you will hear an audio warning—pulsing slowly when the radar is weak, quicker as it strengthens, then constant as you approach close range. When you know exactly how strong the radar waves are, you'll know when the radar unit is near enough to actually have you under surveillance.

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OLD HOUSE RESTORATION

BY BOB VILA

Dealing With An Old Foundation

ALTHOUGH built to last by those who came before us, old-house foundations are vulnerable to the wear and tear of time and the elements.

The key to preserving and maintaining these brick and stone walls is periodic inspection to prevent small problems from growing into big ones. The usual maintenance is repointing the joints between the old brick or stone.

Let's take a look at what a home inspection entails and discuss the best way to re-point those old joints.

Spotting trouble

Your first line of defense against foundation problems is keeping the exterior of these old brick or stone walls in good condition. The integrity of the lime mortar joints must be maintained to prevent water penetration. If water does get inside, the normal freeze-thaw cycle will cause the masonry to move and crack and allow even more moisture in. Also, it's best to keep all plant materials at least 16 in. from the face of the wall to prevent problems that can be caused by the roots.

Most homeowners are aware if there are any areas where bricks, stone or mortar are missing, chipped or cracked. Obviously, situations where there's been a major loss of material demands that the building be shored up before the repair work is done. This is not a do-it-yourself project. But repointing patches of masonry, although labor intensive, is something an old-house owner can tackle with a great deal of success.

You should also check the

Contributing Editor Bob Vila is host of public television's "This Old House."



Old foundations have a lot of character but demand regular inspection and maintenance.

interior walls and ceilings of your house for signs of cracking in the plaster or drywall. Although some cracking is normal—usually it's a result of cyclical movement in the soil or shrinkage of the materials themselves—wide gaps where you can stick your finger or a ruler are another story. If you note these or any other major movement of the walls, it's time to get some professional advice from a contractor or structural engineer before you begin any masonry work.

Restoration masonry basics

There's a major difference between the way restoration masonry work is done and what's commonly done in new masonry work today, and that's the type of mortar that is used.

Too often, portland cement mortar mix is used to repoint old joints that were originally lime mortared.

You must keep the materials compatible, and old lime mortar and new cement mortar just don't mix. The latter

is much harder than the original. Therefore, cement mortar can cause cracking and spalling of the brick and stone because the stronger material shrinks or moves at a different rate than the original lime mortar. And when something has to give, it's usually the old brick or stone and lime mortar. Ultimately, this harder material will destroy its surroundings and completely defeat the purpose of all your repointing efforts.

(Please turn to page 34)



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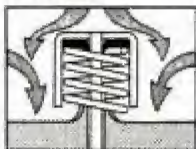


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OLD HOUSE RESTORATION (Continued from page 32)

Mortar matching

It's also important when doing this restoration work that the new mortar match the old in color and consistency. The best way to do this is to try to match the color and size of the sand grains from a piece of the old mortar. Since the mortar on the surface of the joint will have changed color over time, go 1/2 in. or so deeper into the joint to obtain your sample piece. Simply pulverize it with a hammer to visually check the color and grain size.

When it comes to tinting agents, iron oxides are the best way to go. These oxides are available at masonry supply outlets. The tint is anywhere from 1/2 to 2 percent of the volume of the mix. Start with about 1/8 teaspoon as a base, and work your way up from there. Make four samples and let them sit four or five days (the mortar will lighten up considerably over time) and see which one comes closest to the original color. Then, try going a little above and a little below this mix, to give you two more shades to choose from. Out of the three, one should be close enough so that your repointing blends in with the rest of the wall.

Mortar mixing

A standard mortar starting mix for restoration work is 1 part portland, 2 to 4 parts lime and 8 to 12 parts sand. You may have to do some experimenting with the different kinds of sand available locally before you choose what's best. It's okay to mix different kinds of sand to try to get the consistency of the mortar as close to the original as possible. Keep the mix relatively dry—it's easier to work with and you'll get less splattering. Try to be as neat as possible, because this will reduce the time spent on cleaning the surface when you are done.

Repointing

The basics of repointing hold true for any foundation work. First, the joint must be cleaned out to a depth about three times the width of the joint. So, if you're working on a 1/2-in.-wide joint, cut it back to 1 1/2 in.

Various sized cold chisels and stiff wire brushes are good cleaning tools. Be sure to brush away all the mortar before adding your new mortar.

Keep the joint moist and layer in the new material—don't try to fill it all at once. On interior walls or any areas below grade, it's okay to fill the joint flush with the wall surface. On exposed areas, shaping the mortar in a V-joint to expose the edges of the brick looks nice.

The unevenness of the joints in a rubble or stone wall makes this repointing project a bit harder. A general rule of thumb is to show as much of the building material (in this case the stone) as you

can. Keep the mix as dry as possible, drier than you would for brick. You'll need a variety of different size pointing tools on hand to fill the different size joints, and will find yourself switching constantly between them. These are commonly available at masonry supply houses.

Cleaning the wall

The final step in this job is aging and cleaning the results of all your hard labor. This must be done a day or two after your repointing is complete. Don't wait any longer since you must do this while the mortar is still soft and hasn't completely cured.

First, wet the wall down thoroughly—really saturate it. Then apply a weak solution of muriatic acid to the new spots you've pointed. Generally, you'll end up with a solution that is 4-, 5- or 6-parts water to 1-part muriatic acid. (The acid is sold in a solution form to make it safer to use. Therefore, the solution you create for cleaning your masonry work is dependent on the strength of the acid solution you buy.)

There's an easy way to arrive at the right mix. Add a little acid to a bucket of water and drop in a piece of the new mortar. If it doesn't foam, add a little more acid. The minute the mortar foams, you've attained a chemical reaction between the lime and the acid, and the mix is ready.

Just brush it on the wall with a soft or natural bristle brush. Don't leave it on for more than a minute or two. Follow this with a thorough rinsing with a hose. Only tackle patches of 10 to 15 sq. ft. at a time. No matter how good you are, you're bound to slop a bit of the mortar on the face of the brick or stone. But if you kept the mortar mix dry, it shouldn't require lots of elbow grease or a strong acid solution to remove the mortar stains.

Aging the wall

In addition to cleaning the surface, the muriatic solution will eat away the smooth surface of the new joints to expose the aggregate mix and make it look a little older. When you work mortar with a metal tool, it drives the aggregate or sand deeper into the crack and brings the cement to the surface, creating a smooth, glassy look—just what you don't want. Old mortar joints are worn back a bit over time, so the aggregate is already exposed. Etching the newly pointed surfaces will give your restoration work a more complete match with the original mortared joints.

Living successfully with an old foundation involves knowing how to handle the minor repointing jobs that arise from time to time and prevent them from growing into major foundation problems.

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MOTORSPORTS

BY TONY SWAN

A New Park In The Heartland

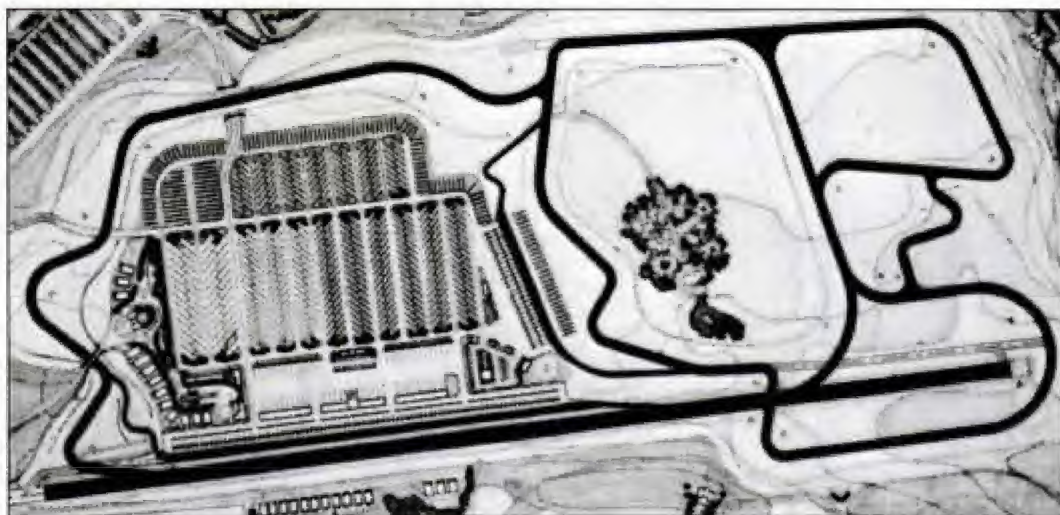
ALTHOUGH there are a number of organizations talking about new motorsports facilities these days, here's a complex that is actually competition ready. It's called Heartland Park Topeka, a multi-use facility located about 5 miles south of Topeka near Forbes Field airport.

Included in the \$10-million, 740-acre complex are several road racing courses, a dragstrip and a 1¼-mile circuit designed for NASCAR racers, as well as a racing paddock capable of holding 600 cars. The longest road racing setup is 2½ miles, including a substantial chunk of the dragstrip and a long back straight. The long circuit is designed to accommodate high-speed events like the IMSA Camel GT, but shorter versions of the course can be sectioned off.

The circuit is 60 ft. wide down the entire length of the dragstrip and 40 ft. wide everywhere else.

Heartland Park can accommodate about 100,000 spectators, with grandstands and "viewing berms."

The new circuit has a number of tuneup events scheduled before an American



New Heartland Park facility is designed to accommodate road racing, drag racing, 100,000 spectators.

Motorcycle Assn. championship meeting the weekend of July 1-2. Other major dates on Heartland's inaugural calendar are an IMSA Camel GT weekend, August 12-13, National Hot Rod Assn. Nationals September 29-30, October 1, and an SCCA pro show—Escort Trans Am, Toyota Formula Atlantic, SCCA SporTruck and Escort Endurance Championship finale—October 13-15.

For details regarding the 1989 schedule, write the track at 7103 Montero Pkwy, Topeka, KS 66619, or call (913) 862-7223.

The First Lady Of Funny Cars

It's probably a little sobering to wake up one day and realize that somewhere along the way you've achieved the status of pioneer. But in racing, as in most of life, that's the way things evolve—they sneak up on you.

When Della Woods started driving her brother's Dodge Charger at local events in Michigan back in 1965, she wasn't out to invade one of the last all-male bastions in motorsports. She just liked the rush that went with flat-out acceleration—something a number of street cops had noticed about her on Detroit's Woodward Avenue.

But when the National Hot Rod Assn. denied Della and contemporary Paula Murphy pro licenses to drive in the emerging Funny Car Class, suddenly there was an issue that went well beyond mere competition. NHRA officials thought it inappropriate for ladies to be driving these fire-snorting, nitromethane-powered monsters. It wasn't just fun anymore. Della had something to prove.

And prove it she has. Della was the first woman to crack

200 mph, and the first woman funny car driver to break the 6-second barrier with a terminal speed of more than 240 mph. She also holds the women's composite best at 5.79 seconds/257.44 mph, and is the only woman currently competing in funny cars.

Like Shirley Muldowney, Della has also accumulated some battle scars along the way. A blown engine near the end of a run at Phoenix in October of 1986 sent Della's Dodge Charger into the pit rail and Della to the hospital with three broken ribs, bruised kidneys, a knee injury and a concussion—keeping her out of action throughout 1987 and most of 1988.

But one of the great motivational facts of life in racing is that there's *always* something to prove. Which is why Della and her husband/crew chief De Nichols, himself a former AA fuel dragster driver, are busily putting together sponsor packages for 1989.

Because for all her pioneer status, Della still has a modest goal or two. "I'd really like to be world champion before I quit," she says.

Now *that* ought to attract some attention.

PM



Della Woods and husband De Nichols tune up for '89 funny car wars.



TWO BODIES, ONE SOUL.

These two machines share a great deal more than just a name. The one on the top likes to win at the track. It's the specially modified Daytona Shelby that posted IMSA GTU victories this year, dusting competitors like Porsche and Nissan in the process. The one below likes to run on the street. It's the Daytona Shelby you'll find at your Dodge dealer. Available over the counter with 174 intercooled turbocharged horsepower. Multi-point fuel injection. Vented high capacity 4-wheel disc brakes. Speed rated 16" tires. And a close-ratio 5-speed Getrag gearset. So what's the connection? Simple. At Dodge, soul-stirring performance is what we're all about. And whether we're at the races or on the road, we don't hold back. For anything. Or anyone. **770**



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OUTDOORS

BY JOE SKORUPA

Invasion Of The 'Water Snatchers'

BE ON THE lookout this summer, shore-dwellers. Splashy aquatic aliens are invading the waterways. Strange jet-powered watercraft are descending in hordes on our shores. They're new. They're odd. They're taking over. It's time to take a stand!

The first time I heard this alarm, or something like it, I made a mental note that here's another case of predictable resistance to something new. Ignore it and it'll go away. The second time I heard it, I paid closer attention because I discovered legislation is being passed to ban personal watercraft (PWCs). New Hampshire, I learned, has all but outlawed the minijets with sweeping rules governing their use. Why? What happened in the Granite State?

It's the law

I found the answer in a recent issue of the "Small Craft Advisory," published by the National Association of State Boating Law Administrators. As of Oct. 1, 1988, according to the report, personal watercraft are prohibited from operating on any body of water less than 75 acres and on 15 specified lakes more than 75 acres.

The New Hampshire law doesn't refer to personal wa-



Wetjets splash freely country-wide except in New Hampshire, where severe restrictions were imposed.

tercraft specifically. The term personal watercraft is defined by the Coast Guard as an inboard-powered craft using a water-jet pump as the primary source of propulsion and operated by a person sitting, standing or kneeling on the craft rather than in the conventional manner of boat operation. In short, they're classified as Class A inboard vessels.

The New Hampshire law refers to something it calls "ski craft," which is defined as any motorized watercraft less than 13 ft. in length, capable of 20 mph, and possessing the capacity to carry no

more than the operator and one other person. Although, the wording is vague, the message is clear: Personal watercraft aren't welcome in the Granite State.

PWC convert

I've only recently become a fan of PWCs. My first two experiences—on the high-off-the-water Ultranautics Wetbike and the standup Kawasaki Jet Ski—were less than memorable. The problem was that I just wanted to turn the key and go. Few athletically gifted people can do that with the demanding models I learned on, despite the claims.

But a revolution has taken place in the last couple of years with the appearance of low-to-the-water, sitdown PWCs. These new-wave models actually allow people like me to sit down, turn the key and blast off.

One of the first was Wetjet, made in Paynesville, Minnesota, which debuted about five years ago. Wetjet's wide 32-in. beam, wheel-type steering, 2-person capacity (which doubles

the fun) and 38-mph capability made it a successful, rider-friendly alternative.

Yamaha was the next major player to jump into the sitdown PWC market. Its popular Yamaha Waverunner, perhaps more than any other craft, sparked the current nationwide boom in PWCs. The Waverunner successfully opened the door for large numbers of family and weekend users, as opposed to the limited group of youthful athletes attracted to the pioneers in the field.

Another important player made a big splash just last year, Bombardier, of Lachine, Canada. Although Bombardier is famous for its Ski-Doo snowmobile, it actually developed a PWC as early as 1968. This "water scooter," as it was informally known, was ahead of its time and quietly faded away after a few seasons on the market.

However, Sea-Doo—the official name of Bombardier's 1968 trailblazer—was resurrected last year and appears headed for long overdue success. (See "New-Wave Wa-

(Please turn to page 43)



The new, sitdown Kawasaki TS heads for unrestricted waters.

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\$112.01/month (84 months)*
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models from \$5,399.*

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each package to make boating more affordable.

To make sure you get more for your money with any Astro.

WORLD'S WIDEST CHOICE OF FISHING RIGS.

There are 46 Astro models in all. In polyglass. Or all aluminum. With flat bottoms to deep Vs. Tiller rigs to dual consoles. Family fish 'n ski boats to full-dress tournament rigs.

For crappie lakes to big northern water, there's an Astro with the equipment, power and price to fit the way you fish.

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*Astro Quickfire 18FS Mercury 150hp,
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accessories that range from extra-comfortable, all-weather swivel seats to guide boards and bearing protectors on the trailer. And packages start at a total price of only \$1,899.

Your Astro's no-extra-charge accessories can include everything from Lowrance® fish locators and Mercury Thruster® trolling motors, locking storage and large casting decks to full instrumentation, deep-cycle batteries and tournament aerated recirculating contoured livewells with automatic aerator timers.

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And find out how much more affordable boating can be. Your Astro dealer has complete details on convenient MMAC financing.

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Prices listed are SPRING SALE Prices for a limited time at participating dealers EAST of the Rocky Mountains. Because of additional freight expense, prices are slightly higher at participating dealers West of Rockies.

**Limited warranty. Warranty details available at local Astro dealer.
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Highest K And X Band Sensitivity

Road & Track, Nov. 1988

BEL VECTOR 3 Radar Detector



Model 976

In *Road & Track's* recent test of currently available radar detectors, BEL VECTOR 3 rated number one in both K and X band sensitivity. Rarely is one radar detector best in both K and X bands. In fact, VECTOR 3 posted the highest K and X band sensitivity levels ever recorded! The results confirm BEL's performance advantage:

"...Vector 3 maintains a BEL tradition of excellent sensitivity, posting the highest figures in this survey for both K and X band radar." *Road & Track, Nov '88*

It's now clear. BEL technology offers unmatched performance. And with today's sophisticated radar equipment, nothing is more important than the best possible performance.

VECTOR 3's performance edge is achieved by adapting a technology used in military satellite communications. We call it Image Rejection Technology®, or IRT®. And through its use, VECTOR 3 provides a level of sensitivity unequaled by any other radar detector manufacturer—a definite advantage for detecting Instant On or Pulsed radar. And when Instant On or Pulsed radar is encountered, VECTOR 3 warns you with a separate audio alert.

But outstanding sensitivity isn't your only advantage. VECTOR 3 also detects Ka band

radar, now increasing in use throughout the U.S. and Canada. And VECTOR 3 also effectively reduces false alerts from non-police sources without any loss of sensitivity to police radar.

Laboratory Tests*

Model	Sensitivity, dBm/cm ²	
	X-band	K-band
BEL Vector 3	117.2	115.6
Audiovox RX-4	104.1	93.9
Cincinnati Microwave Escort	112.9	106.8
Cincinnati Microwave Passport	114.1	107.8
Cobra Trapshooter RD-3170	113.4	110.8
Fultron 15-0900, Snooper D-4000	109.4	108.8
Kraco KRD-16	102.7	104.7
Mascot PH222	101.5	94.6
Maxon RD-25	109.3	106.8
Radio Shack Microtona Road Patrol XK	107.6	106.0
Uniden RD9XL	113.1	108.8
Whistler Spectrum 2	115.6	110.4
Average unit	110.1	106.3

Source: *Road & Track*, Nov. 1988

*Conducted by Advanced Product Evaluation Laboratory, Inc.

BEL VECTOR 3 is the only unit in this test that also detects Ka band radar.

The IRT® Difference

A police radar signal is often buried by microwave "noise", making it invisible to ordinary superheterodyne detectors. Image Rejection Technology® however, reduces this surrounding microwave "noise" making the same police radar signal visible for early detection.



How a conventional superheterodyne radar detector sees a police radar signal.



VECTOR 3 with IRT® sees the same signal clearly by reducing microwave "noise".

Performance this complete also includes a long list of features that makes driving with VECTOR 3 easy and convenient.

VECTOR 3 is only **\$279.95** and comes with a full one year warranty on parts and service. To order your VECTOR 3, or to obtain the name of a dealer near you, just call toll-free.

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BEL-TRONICS LIMITED
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The new Wildcat sports pickle-fork design.

tercraft," page 79, Sept. '88, for a hands-on report and comparison test of the Yamaha Waverunner, Bombardier Sea-Doo and three other models.)

With the revolution in PWC design, and the resultant boom, it's not surprising to see the minijet originators, Kawasaki Jet Ski and Ultranaotics Wetbike, leap into the fray. Debuting this year are the Kawasaki TS and Ultranaotics Sea Flash. Both are 2-rider, sitdown PWCs. The Kawasaki TS is equipped with the same 635-cc powerplant as the popular 650SX and X-2 Jet Skis. The Sea Splash is powered by Suzuki's 798-cc, 60-hp engine. Both promise to zip along about 40 mph.

Another new PWC, the Wildcat, manufactured in Miami, Florida, also debuts this year. It's equipped with a 430-cc, 45-hp engine. (Look for a follow-up report on these new models in an upcoming column.)

A loony issue

But with success—PWCs have exploded in the last two years—comes a price. Legislative bodies throughout the country have finally taken notice of minijets. According to Tony Harkey, product manager of water vehicles for the Yamaha marine group, in addition to New Hampshire, several neighboring townships on Long Island, in New York, are joining together to ban PWCs on lakes and waterways in their jurisdiction.

Many other governing bodies are currently trying to restrict PWC use by forcing them to operate at least 150 ft. from shore, or at least 150 ft. apart.

The New Hampshire situation, however, is the most troubling, since it's the first passage of statewide regulatory legislation. (Similar PWC regulations are currently pending in several other states.) Even more troubling is the purported reason the legislation was deemed necessary.

Unlike the uproar caused by 3-wheel ATVs (see "ATV Wheels of Misfortune," page 26, May '88), safety was not an issue. There is no body of data showing that accidents and injury are occurring at levels higher than that of pleasure boats in general.

What, then, moved Granite-State lawmakers to take such drastic action against PWCs? The answer is protection of a threatened species of bird—the

loon. Although the loon isn't the state bird—the purple finch holds that distinction—it's apparently near and dear to New England hearts.

Now, I'm as environmentally concerned as most avid outdoorsmen, but I can't understand why PWCs are more potentially harmful to loon habitat than, let's say, fishing boats? Or ski boats? Or cruisers? Or runabouts? Or, well, any motorized watercraft.

Shock of the new

I've heard that the New Hampshire PWC legislation is the result of action initiated by a single influential lawmaker who lives on a lake, where, reportedly, PWCs were seen "chasing down loons." This same lawmaker was quoted as saying that minijets were heard "starting up at 6 a.m. and they're noisy."

The real reason that PWCs are being singled out by legislators, I believe, is that they're the new kid on the block. Windsurfers experienced a similar backlash in the early 1980s. Other products also endured short-lived periods of controversy in their formative years.

Ironically, the PWC industry is among the most safety conscious groups in the country. Its umbrella organization, the Personal Watercraft Industry Assn. (PWIA), has developed safe operational guidelines that it distributes in copious quantities ("Fun With Safety On Your Personal Watercraft" is the name of PWIA's booklet. For a copy, write to the PWIA at 401 N. Michigan Ave., Chicago, IL 60611.) Individual PWC manufacturers are equally active in promoting safe operation, and most distribute instructional videos.

But, as mentioned earlier, safety isn't the issue. Here's another of the *real* reasons PWCs are under attack: "It's not so much Jet Skis that I'm against, but the people who ride them," wrote a boating colleague of mine recently. The gist of his complaint was that PWC users often ignore common courtesy and basic rules of the road.

Well, few recreational products I'm aware of don't suffer from occasional operator misuse. Perhaps PWC operators, in the present atmosphere, need to make a better effort to act like responsible waterway citizens. But the point I'd like to make is, isn't a PWC essentially a boat? Is legislation fair that singles it out for restrictive regulation?

People who enjoy PWCs should, naturally, operate in a safe and courteous manner. They should also watch for potential trouble brewing in their local legislatures. The motto of New Hampshire, ironically, is "Live Free or Die." Unfortunately, this no longer applies to use of their waterways. So who are the real water snatchers, the minijets or the lawmakers?

PM

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ARMSTRONG 

ELECTRONICS

BY STEPHEN A. BOOTH

Digital's Future: Bits And Pieces

ALTHOUGH this is our April issue, the items presented here are not April Fools' jokes. Let's begin with the picture of the gigantic cassette, shown to the right.

You're looking at a tape for digital video recording. As you can see, it is many times larger than the one that fits comfortably in the palm of your hand. The smaller cassette is a digital audio tape, for the sound recording machines sold in Japan and Europe, but not yet officially introduced in the U.S.

The DAT cassette holds 90 minutes of music, and is about the same size as an 8mm videocassette—that is, just slightly smaller than the conventional audio cassettes sold since 1964. The much larger digital videocassette holds about the same amount of time, some 94 minutes. Yet it is about the size of a briefcase. As you might surmise, it takes an awful lot of physical space to contain video signals, because they are so much more complex than audio.

Digital video is for real. At the present time, it is coming into use for broadcast production—commercials, sometimes entertainment programming—although 1-in. analog videotape remains the production standard. As in hi-fi audio, the digitized



Digital videotape dwarfs digital audio cassette, which you can listen to with \$4000 headphones.

information offers much more accurate reproduction of the original event.

The day will come when all home VCRs use true digital recording technology—not merely digital picture enhancement (such as the digital video noise reduction in NEC's VCRs) or special effects (such as freeze-frame). But don't hold your breath. As you might imagine from the size of the cassette, today's digital VCRs are quite large—too large to sit in your living room. Meanwhile, 94 minutes is not a lot of recording time—not if you're used to recording 2, 6 or 8 hours of programming on a paperback-size VHS cassette.

Digital Notation

What's needed to make digital video a household item is digital compression technology, that is, a form of mathematical shorthand that would create more space on the tape by combin-

ing redundant signals. It's already in the works. In fact, digital compression is already available in the music field. It's incorporated in electronic keyboard instruments such as the Ensoniq Piano shown below. The Model AWP-5000 (about \$3500) measures only 54 × 18 × 31 in. and weighs in at 105 pounds. Yet the stringless instrument's 88-note keyboard delivers sound comparable to that of a 9-ft. grand piano. The storage space required, says Ensoniq, is 12 million bits of musical info.

As you might imagine, the tones of a real piano are stored digitally on a computer memory chip. If you were composing a ditty on the piano, you could record your opus—digitally, of course—on the AWP-5000's tapeless digital recorder. The solid-state memory device can hold up to 2700 notes. That, according to Ensoniq, equals about 10 4-part songs.

The piano's amplifier and loudspeaker system is supplied by Bose. You can practice your scales silently, by

plugging in headphones. If nothing but the best will do, Sony will custom build a set for you—for about \$4000. While you're saving up, you can see the MDR-R10 'phones on this page.

Fancy Phones

As a blue-skies project, Sony's hi-fi engineers set themselves the task of making the finest headphones possible for digital audio reproduction. To come up with the ideal shape for the earpieces, they used the latest computer-aided design and manufacturing programs. Then, blueprints in hand, they sought the finest materials—including some rather exotic metallic and plastic compounds, wood from 200-year-old Japanese zelkova trees, and luxurious Greek sheepskin. This Stradivarius of headphones is finding favor among professional recording engineers.

Because the MDR-R10 is handmade on a custom-order basis, Sony produces only about one unit per week. The backlog for orders, at this



Ensoniq piano merges digital storage and recording with Bose sound system.

writing, is about six months. The 'phones come with a lockable, hard-shell case. But you might want to rent out a safety-deposit box, too, and do your listening in the bank's vault.

Remote Remotes

The handheld remote control allows you to control your electronic components from anywhere in the room. The next step has to be controlling your electronic components from anywhere in the house. Sound far-fetched? Not really. More and more electronics companies are developing gear that allows you to do exactly this.

Luxman's ultimate controller, for example, is called the TP-117 (\$1800). Each TP-117 contains two separate pre-amplifiers so that the signal source and volume control can be independently operated for two different rooms. This means that a compact disc can be playing through a pair of speakers in one room while the radio plays through a second set of speakers in another room. Furthermore, the TP-117 can be interconnected to expand this capability to many more rooms if desired.

If you happen to be in the room without the electronic components you can still change signal sources if you want. Luxman's RC-501 (\$100), installable in any room, detects the infrared beam emitted by Luxman's handheld remote and transmits the instructions via a coaxial cable connected to the TP-117. The TP-117 delivers your instructions to the appropriate component.

Non-Luxman branded components can be controlled with the RC-503 infrared repeater. The RC-503 (\$150) re-transmits the infrared signal received by the TP-117 or RC-501 to the sensor of the non-Luxman component—first translating it into the non-Luxman unit's code. The RC-503 has to be aimed at the unit's sensor. A small external infrared emitter, the RC-504 (\$20), can be used in tight quarters.

Remotely operated multiroom audio/video systems used to be the sole province of professional audio system installers. Although it's still an expensive and elaborate job, a full-featured multiroom system is not as intimidating a task as it once was, thanks to the type of gear Luxman and other companies are now offering.

New And Offbeat

We've survived another Consumer Electronics Show, this one a 4-day cornucopia of new products in Las Vegas. Although we'll be reporting the news in greater depth in future issues, here's a wrapup of the more noteworthy items.

Just when we'd thought we'd seen everything—at least in personal electronics (see "Digital Diaries," page 73)—we encountered a talking diction-

ary and a battery-powered Bible with LCD display. Only in Las Vegas.

The talking book is Franklin Computer's Language Master 4000 (\$400). Like the company's other LM products, it combines a full dictionary and thesaurus in a paperback-size package. But the LM4000 also incorporates speech-synthesis technology, to give you the proper pronunciation of words.

The DC-powered version of the Good Book hails from Minneapolis-based Selectronics, and is called the Electronic Bible. This pocketful of miracles contains the entire text of the *Old and New Testaments*, and you can read chapter and verse on its liquid-crystal display screen. In case you don't know the specific chapter and verse you're looking for, you won't have to scroll from Genesis to Apocrypha. Just punch in the words you know (for example, "Garden of Eden") and the device will locate all such references. The Selectronics Bible will become available this spring, at about \$199.

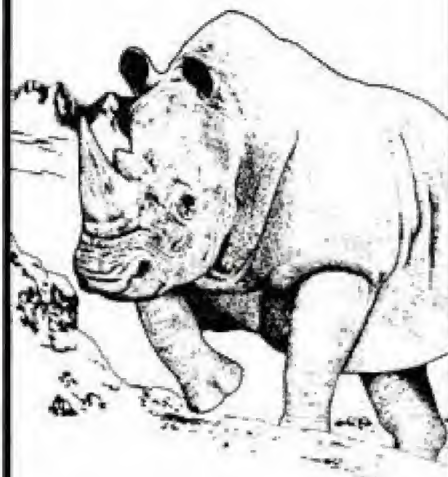
Phone Messages

Among the other interesting items at the CES was Sanyo's Writingphone. It incorporates an LCD screen and tablet upon which you can write messages or sketch images for the person you're speaking to—while you speak. If the party wants a hard copy of the information—let's say a map you've drawn—the Writingphone will print it out on a roll of thermal-sensitive paper. Much like a telephone answering machine, the Writingphone also can store graphic messages while you're away. The innovative telecommunications device works on regular phone lines. There's no price or delivery date as yet, but Sanyo says it will be available sometime this year.

In the telephone area, more videophones were in evidence in Las Vegas—but unlike existing versions, they're color videophones. Again, there's no price or delivery date.

In videogames, the action was hot and furious. Mattel Toys introduced its Power Glove, an accessory for Nintendo games. In place of a joystick or control pad, you simply don the electronic mitten and control game action with movements of your hand. The Power Glove plugs into the game console. Meanwhile, you can go at it barehanded with U-Force, a Nintendo accessory from computer software publisher Broderbund. The device eliminates the need for joysticks and controllers. Instead, it exerts a 3-dimensional force field that detects your hand and body motions, and relays them to the game console. You could, for example, physically duke it out with Mike Tyson—at least his videogame personality. Stay tuned for details on U-Force and other new toys. **PM**

RHINO TOUGH



Whether driving on or off the road, you want tires that can really take the punishment.

Like our Norseman All Season. With a road gripping tread, a patented Tredloc® belting system of woven aramid, and a 40,000 mile warranty.*

See your local Armstrong dealer today for the tires built tough as a rhino.

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ARMSTRONG 

CAR CLINIC

BY MORT SCHULTZ

Back To The Future

THERE'S more to say about two problems from 1988 columns—the item in November “Car Clinic,” (page 48) concerning damage done, if any, to an ignition lock by a key chain laden with keys, and the item in August (page 28) about oil mixing with coolant in remanufactured Ford 360- and 390-cu.-in. engines. Let's not leave any loose ends.

I received plenty of letters with opinions on whether a heavy key chain will or won't ruin a lock. They were split 50:50. One with a different twist, however, came from Bill Snyder, a locksmith in Lutherville, Maryland. He says the weight will not damage the lock, but it could cause a brass key to wear. Most ignition keys are brass. “When the key on a heavy key ring is

inserted into a lock, the key tends to be inserted at an angle. This puts stress on the key which over a period of time can wear and cause a problem,” Bill states. One problem arises if the key gets nicked or cut in a worn spot. The key can break off at this point as it's being turned in the ignition lock. Also, key duplicating machines have trouble duplicating worn keys.

The oil-in-coolant problem discussed in August concerned a 2-year-old remanufactured Ford short-block engine that Rick Mercer of Mattoon, Illinois, put into his 1974 Ford F250 pickup. Doug Anderson, vice president for Product Development of Enginotech, Inc., of Dallas, Texas, advises that Ford 360- and 390-cu.-in. engines can develop a cracked

casting seam between an oil-feed galley and water jacket, usually on the right bank. “The oil feed hole to the rocker arms was drilled off-center in the casting so, in time, the casting seam, being the weakest point, sometimes begins to seep,” he points out. A simple step is to sleeve the hole adjacent to the seam during an engine overhaul by driving a roll pin into the affected area. This covers and seals the seam. “We sell a kit to do the job,” Doug says. “It goes for about \$60.”

Where Air And Water Don't Mix

The air-conditioner compressor in my 1987 Plymouth Voyager (4-cylinder engine) failed after only 1½ years. A mechanic in the dealership service department told me it's an epidemic. He also said I can expect trouble with the new compressor he installed. Why? What do you know about this?

DAVID JACKSON
BIRMINGHAM, AL

The C171 compressor is in a bad location where it's subjected to road splash. When splashed, the belt starts to slip. Compressor head pressure rises, which can wipe out the bearings. That's what I know. What I don't know is how to fix it—for example, how to attach a plate that will protect the compressor.

Until Chrysler comes up with better solution, all I can suggest is examine the belt frequently, and adjust it to 80 pounds (115 pounds if you put on a new belt) using a belt-tension gauge.

And avoid driving through puddles with the a/c or defroster on. Defroster? On many vehicles the a/c compressor is on in damp weather to help dry out the air being blown onto the windshield, at

least when it's warm enough for the window to be misted over rather than frozen.

Powerful Pellets

I've been losing coolant from the 3.0-liter engine of my 1984 Oldsmobile Cutlass Cierra (34,000 miles). The dealer blames a leaking head gasket and wants to install a new one—at considerable cost. Is this a very common problem?

EDWARD STURZ
HYDE PARK, NY

Since we addressed this issue in the November 1988 “Car Clinic,” additional information has come to light. Yes, coolant loss is a problem affecting both 3.0- and 3.8-liter engines. Yes, a new head gasket may be needed (also new head bolts in the case of the 3.0-liter engine). But anyone who doesn't investigate all aspects of this situation before tearing off the heads may be throwing away money.

Whenever a 3.0- or 3.8-liter engine experiences coolant loss, the mechanic should first follow the cooling system diagnosis procedure in the service manual. When inspecting for leaks, he should pay close attention to hose clamps and remote areas that may leak—such as core plugs and the area around the throttle body. Then, before making any shot-in-the-dark repair, like replacing a head gasket, drop three sealer pellets from GM Engine Coolant Supplement kit (part No. 3634621) into the radiator and drive the car a while to see if the leak stops. No luck? Before taking someone's word that a head gasket is needed, be sure you've eliminated all the other possibilities. Leakdown and cylinder compression tests may give indications whether head

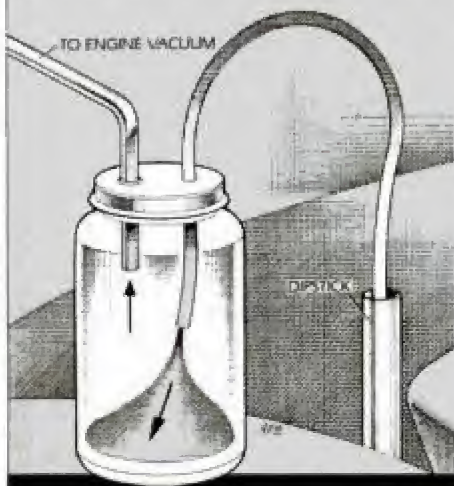
(Please turn to page 48)

Levelheaded

Thanks to a mistake made by J. Shinkunas of Sioux City, Iowa, we have this gem, which we tried and found to work like a charm. J. S. inadvertently overfilled the automatic transmission in his Ford. This is definitely not good—it tends to froth, leak and overheat—so it had to come out. But how? J. S. wondered, since he had no suction device available. That's when his ingenuity came to the fore. J. S. got an empty jam jar, drilled two holes in the cover, and soldered a length of 3/16-in. copper tube to the cover at one hole. He pushed windshield washer hose into the other hole and



screwed the top back on the jar, making sure it sealed tightly. He then fed the windshield washer hose down the transmission fluid filler tube, connected the copper tube to what he calls “any good vacuum source,” started the engine and applied vacuum. The overfill slurped into the jar bringing the level to spec.



Quality is Job 1.

Profile in quality #3: Prevention.

Ford Motor Company believes in prevention. Beginning with the prototype stage, we test models of our Fords, Mercurys and Lincolns on a gruelling "roller road" shaker machine. While this is going on, our engineers are listening for possible squeaks and rattles with highly sensitive stethoscopes (much like your doctor uses). By doing this, we can help engineer squeaks and rattles out, before you ever get in. When quality is job 1—you don't do it any other way.

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**Our goal is to build the highest quality cars
and trucks in the world.**



Buckle up—together we can save lives.

gasket replacement is or isn't necessary. Also it's possible to use an emissions analyzer to sniff out carbon monoxide leakage into the cooling system from the combustion chamber.

The Wanderer

My 1983 Ranger has always had a mind of its own, drifting on a flat, straight road when I take my hands off the steering wheel. My brother has a 1985 Ranger that handles like a charm. I've gone the whole route trying to get my truck to perform like his—wheel alignments, new tires, tire rotations and inflating and deflating tires to various pressures. Nothing helps. What's wrong?

DANIEL GOMEZ
LOS ANGELES, CA

What's wrong may lie with what's called the ball joint adjuster slugs. They're used for adjusting front wheel camber. If the slug is not installed properly, the ball joint binds and the vehicle will give a relatively heavy pull to the side having the misadjusted slug. An improperly installed ball joint adjuster slug could have been put on your truck in manufacture, or a mechanic could have introduced the condition when a wheel alignment was done. In any case, have camber readjusted by the book, insuring that the slugs are properly installed.

Other reasons for a relatively light drift are: tire conicity (tires that are worn more on one side, cone-shaped rather than cylindrical—usually caused by bad alignment), which you've pretty much ruled out, and the fact that your vehicle has a caster split of $1/2^\circ$ to $3/4^\circ$. Caster split means that the caster is greater on the right side of the truck, to compensate for road crown, which tends to make the truck pull to the right. You can determine if this is the reason for the drift by turning the wheel hard all the way to the right. Then, drive to see if you get a hard pull to the right. Now, turn the wheel hard all the way to the left. Drive to see if the truck now tracks straight. If it does, the caster split is the reason for the drift, and there's nothing you can do.

The Ford service manual for the Ranger discusses all this under Roadability, Section 19.

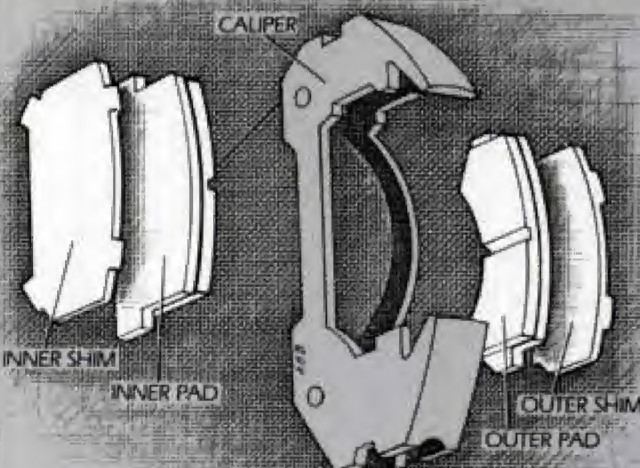
Cat Scanning A Cressida

Every winter I vow it will be the last one I'll suffer through with my 1986 Toyota Cressida. Then, the warm weather arrives, and the car acts like it's the best in the whole world. But when the ambient temperature again falls below 40°F , it requires 20 to 30 revolutions of the starter motor to get the engine going first start of the day. Once it gets going, though, the engine starts promptly the rest of the day as long as it's retained

Pushin' A Cushion

We were wondering if Honda's recommendation to dealership mechanics about using Molykote M77 lubricant to cushion pads as they move against shims, thus quieting noisy brakes, would work on different makes of cars. So we tried it. Yep, it worked—at least for awhile. But if you're going to try it, let me warn you that any squeal, grind or moan you hear should be investigated first to make sure the noise isn't the result of a malfunction that could affect braking.

Once it's determined that the noise isn't safety related and is coming from pads and shims, you can give the method a whirl. Remove pads and shims, and discard old shims for new ones. Whether you're replacing the pads or not, scrape or file corrosion from the caliper so the pads slide freely in their track, and on the retaining



pins, both in and out and laterally. Then, apply Molykote to the metal parts of the pads—that is, to the backsides and to the ends—and to both sides of each new shim.

Don't even think of applying Molykote to the friction surface.

some warmth. The Toyota dealer has done exhaustive testing and finally replaced the fuel pressure regulator. It hasn't helped.

W. R. JENSEN, MD
VALLEY CITY, ND

As a physician, you know there are exhaustive tests and exhaustive tests. I can't figure out why the mechanic replaced the fuel pressure regulator. It has no connection to the symptoms you describe. He would have been better off going after the cold-start injector, which a lot of mechanics try to avoid like the plague on this engine, because it's located in a hellish-to-get-at spot at the bottom side of the intake manifold.

I'm pretty sure the mechanic will find that the cold-start injector isn't working. Either the electrical connector at the injector is corroded, the timer is shot, or the injector is plugged. In any case, the injector isn't providing the engine with that extra shot of gas it needs to start promptly when it's cold. Not every engine with fuel injection has a cold-start injector, but the 5MGE engine in your Cressida does. Now all you have to do is find a mechanic who's willing to stand on his head to reach it.

FM

DO YOU HAVE A CAR PROBLEM?

Just ask Mort about it. Send your question to Car Clinic, Popular Mechanics, 221 West 57th St., New York, NY 10019. While letters cannot be answered individually, problems that are of general interest will be discussed in the column.



SERVICE TIPS

■ Get your 1985-88 model 740 Volvo back to the dealer. There's a recall involving bolts connecting the transmission and driveshaft.

■ GM 1984-89 models sporting THM 440-T4 transaxles are rattling teeth when shifted from Park or Neutral into Reverse. A new reverse band assembly (part No. 8668012) and second clutch housing drum and bushing assembly (part No. 8662936 for 1984-86 models, part No. 8661912 for 1987-89 models) solves the problem. Each GM division has issued its own service bulletin.

■ Fluctuating slow idling speed from 1987-89 Chrysler 2.2- or 2.5-liter engines may be caused by a rubbed-through throttle-body wire harness which has come into contact with the engine. The harness should be inspected to spot abraded areas, which should be wrapped with friction tape, and then tied back away from the engine with a tie wrap. TSB 18-18-88.

■ A lot of 1988 Taurus, Sable and Continental models built from September 1987 through June 1988 may sound like the rattletaps they aren't, all because of a loose front tension-strut bushing retainer in the subframe front crossmember. FoMoCo dealers should refer to TSB 88-24-4.

INSIDE DETROIT

BY JIM DUNNE

Cadillac Heads Back To The Future

IT WILL be a return to the past when this Seville model is introduced to the public as a 1992 model in the fall of 1991. A longer hoodline, a sloping rear roofline, and a more massive appearance overall is what Cadillac plans for its "European-type" sedan.

Note the similarities in front-end appearance between this production prototype and recent Cadillac show cars, the Voyage and Solitaire. According to insiders, the car will continue to use front-wheel drive and an updated version of the current aluminum alloy 4.5-liter pushrod V8 engine.

However, important changes in the size and stance of the vehicle will return the next generation Seville to the position of prestige it once enjoyed among luxury cars, which will be welcome news to Cadillac dealers. Seville sales in



Seville's 1992 styling will borrow from past successes, though Cadillac will maintain current hardware.

that Jeep has been enjoying for some time in the 4-door sport/utility market.

While the vehicle may appear very similar to the 2-door, there are noteworthy changes in addition to the ex-

doors is remarkable, too. The blacked-out frames make the windows appear similar to those in the current 2-door model, creating the appearance of one long, continuous sheet of window glass.

Finally, the intricate wheel design is new, and probably one that will show up soon, as early as model year 1990 on the compact Blazers. Reports out of GM divisional headquarters say that Oldsmobile will also have a version of this vehicle. Why produce a 4-door after all these years of making only 2-doors? That's where the major market is. Jeep sells 85 percent of its Cherokees in the 4-door version, only 15 percent 2-doors.

1990 LeSabre

Moderate facelift is what this kind of change is called in the auto industry. In its 2-door LeSabre models, Buick will change the grille and front bumper to give the car a slightly different appearance. In place of the flat, horizontal grille, Buick will insert a bulging vertical grille, something akin to the 1989 Century.

To augment the impression of change, the bumper will be lowered in the area of the grille, replacing the straightacross look of the 1989 bumper. While the 2-door LeSabre appears to carry over the same sheetmetal as seen on the 1989, the 4-

(Please turn to page 52)



Most of stretch in 1991 Blazer 4-door is behind B-pillar.

the past two years have been running at the 20,000 level, well below the 30,000 that GM expected. The new model should close that gap.

4-Door Blazer Update

This 4-door version of the S-10 Blazer will be introduced by Chevy as a 1991 model to counter the sales success

tra doors. Wheelbase has been stretched at least 6 in., to make room for the rear doors. Note that the front door is almost the same length as the present model, so the added length of the new body style has all been added to the area just behind the front doors.

Chevy's treatment of the window area in the rear



Styling changes for 1990 Buick LeSabre will be confined to front end.

1-800-3

How to Talk to Nine Boat Companies With One Free Phone Call

The Power of Choice...

Until recently, buying a boat and getting it to the water took a lot of commitment. Pick a boat brand. Pick a dealer. Pick an engine. Pick a trailer. Pick a finance company. Pick a marine insurer. Pick!

Pick! Pick!... It was enough to turn a lot of people off. Now the OMC Boat Group; with a stable of nine of the finest names in boating and a network of more than 2100 marine dealers nationwide offering everything from aluminum fishing skiffs to luxurious, live-aboard, wide-body cruisers, has taken much of the hassle out of boat buying. Call us toll free, tell us the kind of boating you're interested in, and we'll direct you to one or more professional marine retailers in your area with a range of complete, water-ready models to fit your brand of water action.



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Marine products are available from many dealers nationwide.

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All OMC Boat Group packages feature the power of OMC, one of the world's leading producers of marine propulsion systems for 60 years, including reliable, corrosion-resistant OMC Cobra®



OMC Sea Drive®

and OMC King Cobra® stern drives, rugged and dependable Johnson® and Evinrude® outboards, and space saving OMC Sea Drive® systems.

OMC Boat Group Dealers not only have your boat, but have affordable prices, on-the-spot financing and insurance for qualified buyers, boating accessories and apparel, and marina services all under one roof. Boating's always been fun. With one free phone call we'll help make it convenient, affordable and hassle-free.

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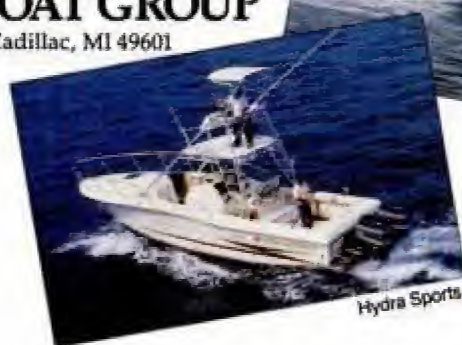
925 Frisbie Street, Cadillac, MI 49601



Stratos



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door will have a new roof and rear quarter panel to go with the new front end.

Quad 4 Quandary

GM is covering all bets in planning its Quad 4 engines for 1992. The current glamour engine in the GM lineup will be available in supercharged and turbocharged versions.

GM insiders say the two techniques give the engine slightly different power characteristics, so they are slated for different types of cars. Superchargers put out power even at low engine speeds, while turbochargers—even the newer ones—tend to build power a little higher in the rpm band.

Look for the supercharged Quad 4 to be marketed as the premium engine, with one of its primary installations coming up in the Toronado. The turbocharged engines are more suitable for smaller, sporty cars like Cutlass Supreme or Calais.

Sticking Together

GM plans to abandon time-honored nuts-and-bolts in building its new plastic-bodied APV vans. Instead of traditional fastening methods, assembly will involve space-age adhesives.

"It's different from the Fiero," reports one GM engineer. "On that car we

bolted the body panels to a metal framework. With the APVs, the plastic is glued right to the metal instead."

When the Lumina, TransSport and newly announced Olds Silhouette hit the showroom late this spring, look at the way the plastic is attached to the doors. You'll see a thin seam between the two materials, but no bolts, welds or screws. The glue assembly approach is just one of the features.

Pretty In Pink

You may see pink and other pastel colors return to new car showrooms later this year as the auto industry reaches into the past to perk up sales. Pastels are popping up at the auto shows with more persistence.

Not since the colorful days of the '50s and early '60s have delicate hues shown such strength in automotive paint jobs. Pastel greens, blues and yellows—and yes, pink—may be the in colors of the 1990s, if car designers' guesses are correct. Car designers at GM say we'll see pastels before the end of the year.

Pastels aren't the only colors in the news. Ford, GM and Chrysler are all slathering Day-Glo brilliance on the exterior of some show cars. And you also see it to some extent on the instrument panels and upholstery as well.

Surprisingly, all three companies are using almost identical shades of bright green. Yellows and reds are also finding their way into newer models, especially those built for recreation.

Chrysler V8

Although Chrysler's big V10 is the engine that's making the headlines nowadays, Highland Park's powertrain designers are busy working on a completely new V8 engine for premium cars of the future.

"It will be all aluminum," reports Chrysler chief engineer Francois Castaing. "And we're looking at a size in the 4.5-liter range."

This is the engine Chrysler will use in its new luxury cars of the mid-'90s. But there is a big "if" involved. Some top executives at the company are not convinced that the investment in a new engine of this type is worthwhile. While engineers and sales people readily see the benefits of a world class V8, others—mainly the infamous bean counters—are afraid to spend the money to make it happen.

Decision time is close. It takes three years minimum to get a new engine off the drawing boards and into the showrooms. So Chrysler must move within the next few months on this project. **PM**

The Ultimate Performance Additive.



There are a number of things you can add to your car to improve its performance. One of the most important is spark plugs.

So, imagine what you would gain by using Bosch Platinum—The Ultimate Spark Plug.

Bosch Platinum is the only plug in the world that uses a 99.9% pure platinum electrode engineered into a revolutionary extended insulator design. As a result, it outperforms other spark plugs by delivering quicker starts, smoother acceleration and improved fuel efficiency.

So if you're looking for the ultimate performance additive, install a set of Bosch Platinum Spark Plugs. And pour on the performance.

Don't miss your chance to win a trip to the Bosch Spark Plug Grand Prix. See your participating Bosch Platinum retailer or service outlet.



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The Ultimate Spark Plug.

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Freedom of Choice.

Visit the value end of many boat lines and it's a short trip... one or two under-powered, under-equipped, spartan-styled "price leaders", also known as "entry level" specials.

Shop the value end of the Four Winns line and you might want to pack a lunch. Here is Freedom of Choice you've never experienced in the affordable-priced sector.

There's something for every boater and every aspiring boater in the Four Winns Freedom line... a 150 Freedom outboard powered bowrider... 160, 170, and 190 Freedom stern drive and outboard powered bowriders... 170 Freedom closed deck outboard and stern drive models... even spacious 195 Freedom outboard or stern drive powered cuddys.

Prices Start Under \$7000... Way Under!

The 150 Freedom, with 48 SPL Johnson® or Evinrude® outboard... AM/FM stereo cassette... built-in 12 gallon fuel tank... integrated swim platform and ladder... ski tow and in-floor ski storage... full instrumentation... convertible top... and color-matched Four Winns Sure



195 FREEDOM™



170 FREEDOM™

Load™ trailer has a suggested list price of just \$6799*.

Each new deep-vee Four Winns Freedom model is engineered efficient, spirited design-matched OMC

for smooth, performance from Cobra® stern drive or Johnson® or Evinrude® outboard power teams.

Backed by Boatings Strongest Protection.

Freedom has one more big edge over everything else in the value class. It's backed by Four Winns exclusive *Winning Edge*™ 3-Year Owner Protection Plan... one year limited warranty, followed by two years extended protection on all major boat systems and components... all at no extra cost. Your Four Winns Professional Marine Retailer has complete details. See him soon and check out the new class of the value class... Four Winns Freedom.



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*Excluding taxes, registration, dealer preparation, shipping, license fees and optional equipment.

Budget Flight

BY FRED MACKERODT, Contributing Editor

MENTION airplane ownership to most people and the first thing they envision is money—piles of money.

But owning a flying machine doesn't have to be all that expensive. A good, serviceable airplane can be obtained for the price of the cheapest new car. Yes, for between \$5000 and \$10,000 you can own a "modern" Cessna 150 or Piper Tomahawk trainer that also won't take you to the cleaners to operate.

Of course, the plane you own will be far from new. But you'll be in good company: Half the private airplanes flying today are over 20 years old; a quarter are more than 30. And there's nothing wrong with an "old" airplane. Properly maintained, older airplanes can be as safe and reliable as much newer aircraft (see "The Ageless Aircraft," page 44, Aug. '88).

Classics for less

The kicker is that for this same money, you can own a classic airplane that delivers a number of additional benefits. First and foremost, the classic probably won't depreciate. In fact, it will most



Cessna 120/140 tail-draggers are super classics but finding parts can be a real challenge.

likely appreciate, in some cases substantially. Second, if you pick right, you will have an airplane that can deliver all—if not more—of the speed and load carrying of much later aviation iron. Third, you'll own a piece of aviation history while gaining a ready-made hobby, a great pastime and a whole new group of like-minded friends.

Thousands of vintage Aerocars, Cessnas, Luscombes, Pipers, Stinsons and Taylorcrafts are available on the market for what you'd pay for the cheapest new Honda Civic.

One reader's Pacer

The experience of PM reader Hank VanValkenburg is a case in point. A 45-year-old corporate jet pilot, Hank was looking for a fun airplane to fly on weekends. He bought the 1950 Piper Pacer shown on these pages for \$9000. What he got for his money was a great looking classic airplane with respectable 130-mph speed, a decent level of traveling comfort and room for four passengers. He also got a great airplane in which to train his 15-year-old son, Kevin, to be a pilot. There is no better airplane to learn on than a tail-dragger.

Expert opinions

Like everything else, however, there are right ways and wrong ways to go about buying vintage airplanes. To get the scoop we spoke with Clyde Smith Jr., an expert on tube and fabric airplanes and a consultant on Piper Aircraft's new Cub kit program (see "The Piper Cub Is

Back," page 58, Oct. '88). Clyde had some tips.

Smith is understandably biased toward Pipers and he cites a number of convincing arguments. The main one is product support. Piper is the only one of the original manufacturers still supporting all of its products, both old and new, with technical information. Help is a phone call away, (800) 72-PIPER. Although parts for most vintage airplanes can be found, a wide selection of pieces for older Pipers are readily available through companies like Univair Aircraft Corp. in Aurora, Colorado, (303) 375-8882, and Wag-Aero in Lyons, Wisconsin, (414) 763-9586. Parts for other vintage aircraft can be harder to get.

Research, research, research

Clyde's first piece of advice to prospective buyers of vintage aircraft is to do a lot of research and legwork. Read

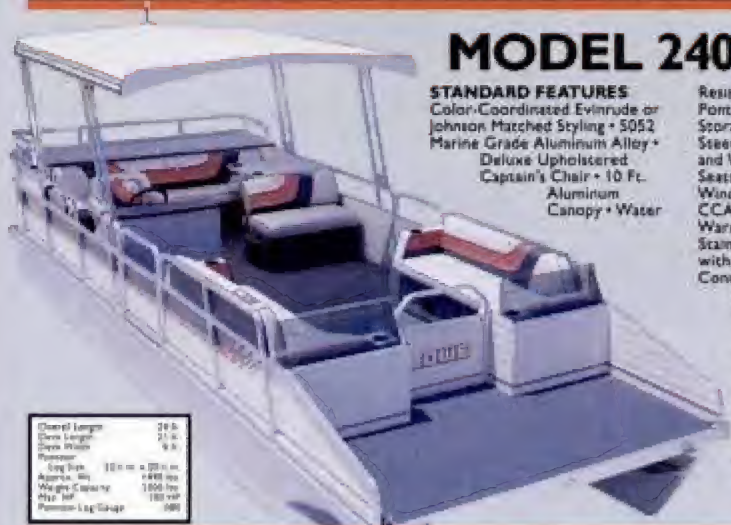
(Please turn to page 56)



PM reader VanValkenburg and son with a 1950 Piper Pacer.

Packages that make your family fun more affordable

**FULLY
EQUIPPED
AND READY FOR THE LAKE!**



MODEL 240

24 Ft. Lowe™ Pontoon Boat • 40 HP EL Evinrude® or Johnson® Outboard

STANDARD FEATURES

Color-Coordinated Evinrude or Johnson Matched Styling • 5052 Marine Grade Aluminum Alloy • Deluxe Upholstered Captain's Chair • 10 Ft. Aluminum Canopy • Water

Resistant Closed Cell Foam Floation in Pontoon • Carpeted Battery and Fuel Storage Area with Battery Box • Deluxe Steering Console with Binnacle Control and Windshield • 2 Full Front Lounge Seats with Connecting Storage Boxes and Windscreens • AM/FM Stereo Cassette • CCA Plywood Deck w/Limited Lifetime Warranty • Carpet • Wheelchair Gates • Stainless Steel and Aluminum Fasteners with Waterproof Underdeck Electrical Connections • Transducer Mounting Bracket • Dinette Table with 2-Way Seat • Full Rear Bench Seat with Arms • Stern Tanning Deck with Separate Fuel and Storage Compartments

OUTBOARD 40 HP EL Evinrude or Johnson • VRO® Variable-Ratio Oil Injection • OMC SystemMatched® Propeller • 6 Gallon Fuel Tank w/Hose

OPTIONAL OUTBOARDS

40TL, 50EL, 50TL, 60TL, 70TL, 90TL, 100GT/KP

OPTIONAL EQUIPMENT

Instrument Package Includes: Speedometer • Voltmeter • Tachometer • Water Pressure Gauge • AM/FM Stereo Cassette • Upholstered Stern Tanning Deck Pad

\$7,995*
COMPLETE PACKAGE PRICE
plus freight, prep., and rigging

Overall Length	24 ft.
Deck Length	21 ft.
Deck Width	8 ft.
Power	
Eng Size	100 to 200 hp
Approx. Wt.	1400 lbs.
Max. Wt. Capacity	1800 lbs.
Max. Hrs. Use	100 hrs.
Power-Log Gauge	100



MODEL 200

20 Ft. Lowe™ Fishing Pontoon Boat • 25 HP EL Evinrude® or Johnson® Outboard

STANDARD FEATURES

Color-Coordinated Evinrude or Johnson Matched Styling • 5052 Marine Grade Aluminum Alloy • CCA Treated Wood Deck w/Lifetime Limited Warranty • Carpet • Water-Resistant Closed Cell Foam Floation in Pontoon

• Upholstered Captain's Chair • Full Rear Bench Seat w/Arms • Full Rear Seat Storage • Livewell Aerated with Freshwater Pump & Automatic Timer • Folding Bimini Canopy • Transducer Mounting Bracket • Stainless Steel and Aluminum Fasteners w/ Waterproof Underdeck Electrical Connections • Deluxe Steering Console w/ Binnacle Control and Windshield • 3 Gates • Carpeted Battery and Fuel Storage Areas w/ 2 Battery Boxes • 2 Removable Upholstered Fold-down Pedestal Mounted Fishing Seats • Dinette Table w/2-Way Seat • 8 Gauge Wire Trolling Motor Socket and Stub • Stern Tanning Deck w/Safety Rail

OUTBOARD 25 HP EL Evinrude or Johnson • OMC SystemMatched® Propeller • 6 Gallon Fuel Tank w/Hose

OPTIONAL OUTBOARDS
40EL, 40TL, 50BEL, 50TL, 60TL, 70TL

OPTIONAL EQUIPMENT

Instrument Package Includes: Speedometer • Voltmeter • Tachometer • Water Pressure Gauge • AM/FM Stereo Cassette w/2 Speakers • Upholstered Stern Tanning Deck Pad • OMC Cobra® 12 Volt Trolling Motor

\$6,295*
COMPLETE PACKAGE PRICE
plus freight, prep., and rigging

Overall Length	20 ft.
Deck Length	18 ft.
Deck Width	8 ft.
Power	
Eng Size	100 to 200 hp
Approx. Wt.	1100 lbs.
Max. Wt. Capacity	1500 lbs.
Max. Hrs. Use	75 hrs.
Power-Log Gauge	100



MODEL 189

18 Ft. Lowe™ Fishing Pontoon Boat • 25 HP EL Evinrude® or Johnson® Outboard

STANDARD FEATURES

Color-Coordinated Evinrude or Johnson Matched Styling • 5052 Marine Grade Aluminum Alloy • CCA Treated Wood Deck w/Limited Lifetime Warranty • Carpet • Water Resistant Closed Cell Foam Floation in Pontoon • Upholstered Captain's Chair • Full Rear

Bench Seat with Arms • Full Rear Seat Storage • Livewell Aerated with Freshwater Pump & Automatic Livewell Timer • Folding Bimini Canopy • Transducer Mounting Bracket • Stainless Steel and Aluminum Fasteners with Waterproof Underdeck Electrical Connections • Deluxe Steering Console with Binnacle Control and Windshield • 3 Gates • Carpeted Battery & Fuel Storage Area with 2 Battery Boxes • 2 Removable Upholstered Fold-down Pedestal Mounted Fishing Seats • Dinette Table with 2-Way Seat • 8 Gauge Wire Trolling Motor Socket and Stub

OUTBOARD 25 HP EL Evinrude or Johnson • OMC SystemMatched® Propeller • 6 Gallon Fuel Tank w/Hose

OPTIONAL OUTBOARDS

40EL, 40TL, 50BEL, 50TL

OPTIONAL EQUIPMENT

Instrument Package Includes: Speedometer • Voltmeter • Tachometer • Water Pressure Gauge • AM/FM Stereo Cassette w/2 Speakers • OMC Cobra® 12 Volt Trolling Motor

\$5,695*
COMPLETE PACKAGE PRICE
plus freight, prep., and rigging

Overall Length	18 ft.
Deck Length	16 ft.
Deck Width	8 ft.
Power	
Eng Size	100 to 200 hp
Approx. Wt.	1000 lbs.
Max. Wt. Capacity	1400 lbs.
Max. Hrs. Use	50 hrs.
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AVIATION (Continued from page 54)

everything you can get your hands on. *The Pilot's Guide To Affordable Classics* (Tab Books, Inc., \$14.95) is good for starters. A publication called *Aviation Consumer*, (203) 661-6111, has done extensive flight tests on most classics. The "type" clubs like the Short Wing Piper Club, (516) 273-5072, and the Cessna 120/140 Assn., (612) 652-2221, publish a lot of excellent material.

When it comes to buying the airplane of your dreams, there is one publication that's a must—*Trade-A-Plane*. Published three times a month, this is the bible of used airplanes. Subscriptions are \$30 per year and you can call (615) 484-5137 for a free sample copy.

Be picky

Study the prices. Piper J3 Cubs are getting up in price and, with 65-hp Continental engines, are low on performance. Some like the PA14 Family Cruiser, of which only 235 were built, have become serious collector's items with prices up to \$50,000. The PA20 Pacer tail-dragger like reader VanValkenburg's (510 are still flying) can be purchased for around \$10,000, but the tricycle-gear Tri-Pacer version in comparable condition can be obtained for considerably less because 5367 with the third wheel in front are still flying. Both the Pacer and the Tri Pacer, however, offer all of the speed and load-carrying ability of newer and more expensive aircraft.

When you've targeted the airplane you want, visit the local airport and strike up a conversation with someone who owns one. There's only one thing that vintage aircraft owners like almost as much as flying their planes and that's talking about them. Ask about costs and the hassles of ownership. Ask about the availability of aircraft in the area.

Whatever you do, don't buy an airplane without getting some expert advice. Get a mechanic with vintage aircraft experience and pay well to have the airplane thoroughly inspected. VanValkenburg sought out Walter Maynard, a tube-and-fabric expert who has a shop at Blairstown Airport in New Jersey. Maynard pronounced the Pacer basically sound, but his close inspection revealed 55 "squawks," most of which were minor complaints.

Review the aircraft's maintenance logs, but don't treat these as the last word. Some repairs are made with pens. Check closely for manufacturer's bulletins and airworthiness directives.

Areas for serious inspection include the steel tube framework which can hide rust, and the condition of the fabric. While the fabric on VanValkenburg's Pacer checked out, the stabilator had to be re-covered because it was covered too tightly when originally done and was cracking at the edges.

Engines are pretty straightforward. They're the same as the ones being made today. Parts availability is also a snap, although prices can be hefty. The engine in VanValkenburg's Pacer was low-time with only 200 hours since rebuild. But an overheating problem fried one cylinder, which cost \$200 to redo.

Buy the best

Don't buy an airplane with a high-time engine, or one with serious problems. It can cost as much to rebuild as the airplane is worth. Buy the best airplane you possibly can. It will work out cheaper in the long run.

Check out the avionics. Make sure the radios and other equipment, like transponders and lights, are working properly. A full set of avionics can easily cost as much as the airplane. While some vintage aircraft will come equipped with the latest transistorized communications equipment, others will sport old tube boat anchors that are heavy, tough to get parts for, and expensive to maintain. VanValkenburg added one used Narco radio (\$700) and a new II Morrow Loran (\$2000) to his Pacer, which is now certified for IFR.

With all of the squawks taken care of, Hank VanValkenburg figures he'll have \$15,000 in his Pacer. But he discovered a way to instantly cut his investment in half. He found a partner: me. I know a good investment when I see one, and the Pacer is the most enjoyable investment I've ever made.

I'm also relearning how to fly. Tail-draggers are a whole new ballgame.

Flying Video

When I originally began learning to fly five years ago, I was a complete novice. I didn't know how much it would cost, where to go, what to ask—you name it, I didn't know it. Getting into the airplane for my first lesson, I didn't even know whether to sit in the left or right seat.

Now, King Accelerated Schools, the leading producer of pilot training videos, has developed a unique product to take the mystery out of flying for the greenest of students. A \$29.95 videotape called "Let's Go Flying" takes the viewer by the hand and explains everything that's involved. Leading off with interviews of famous people who tell why they fly, the 1-hour tape details what it takes to get a license, including what it costs and the best ways to go about getting instruction. It uses in-aircraft video to show how airplanes fly and what the individual controls do. But the kicker of this new King video is that it comes with a certificate, good so far at 180 flight schools across the United States, entitling the holder to a free flight. For more information, call King at (800) 854-1001.

FM

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SUNBIRD

The Video Evolution

BY FRANK VIZARD, Contributing Editor



Sony's new projection TVs offer conventional picture-in-picture, as above, or side-by-side split screen viewing.

MOST of the new video products debuting this spring are not what we'd call revolutionary. Close examination, however, does reveal a few new wrinkles that translate into better performance, flexibility and ease of use.

Sony, for instance, incorporates a few new twists into its KPR-46DX10 and KPR-46CX10 projection televisions that are of particular interest to sports fans. Both of these models are essentially the same 46-in. unit, the only difference being that the KPR-46DX10 is mounted inside a cabinet.

One new twist in both models is a split-screen feature that puts two full-height pictures from two different channels side by side. Both pictures look somewhat elongated but you can still follow the action easily. Sound can be switched from one picture

to the other at the touch of a SWAP button on the remote control.

Sports fans will instantly grasp the utility of the instant replay feature appearing on both projection TVs. At the touch of a button, the last 2 seconds of action can be played back repeatedly. Did the base runner steal second base? You can watch the tag over and over again.

Both projection televisions have a lot of other features more familiar in nature such as picture-in-picture and channel indexing. Both units provide an excellent picture with a horizontal resolution of 600 lines. Both models have three sets of video inputs for plugging in a variety of sources. Two 22-watt amplifiers power a pair of built-in speakers so that the sound is as powerful as the picture. List price is \$4500 for the cabinet-mount-

ed version and \$4000 for the free-standing unit.

Camcorders are becoming an increasingly normal part of the video landscape. Several companies have added new wrinkles that make their products easier to use.

One welcome addition is the CPJ810 camcorder from Philips. Unlike the vast majority of camcorders available, the Philips CPJ810 sports a color LCD viewfinder. So instead of seeing images in black & white, they can now be viewed in color. What you see is just what you get!

The Philips CPJ810 is a SVHS model offering 400 lines of resolution and a low-light lux rating of 7. There's also an 8:1 power zoom and three high-speed shutter settings. List price is \$1899.

Philips, incidentally, appears to be the first on the market with a color LCD

viewfinder but it will hardly be the last. Sharp and others have shown a similar product so expect one from them later in the year.

Hitachi, meanwhile, is touting what the company calls the first fully automatic camcorder, the VMS-8100. The key to this claim is a feature called "Accushot." Though the term seems more appropriate in a Smith & Wesson ad, it actually describes the camcorder's computer-controlled exposure system.

Accushot automatically adjusts the iris and variable high-speed shutter to provide the best possible picture exposure at the highest practical speed.

The convenience of Accushot will cost you. List price for the SVHS VMS-8100 is \$2100.

Accushot notwithstanding, most of us shoot videos the way we would fire a rifle, essentially sighting down the barrel at the target. This stance, however, is not always practical. Canon offers two 8mm camcorders, the E808 and E80, that let you

sight the target from essentially whatever position works best. The viewfinder on both models rotates 180°. Now you can shoot from the hip or even hold the camcorder over your head without los-



Marine casings for Sony's 8mm camcorders let you make videomovies underwater.

ing sight of the subject. The E80, with a 6X power zoom, lists for \$1699 while the E808 with 8X power lists for \$1799.

Ricoh also offers an 8mm camcorder with some flexibility. The eyepiece of Ricoh's R-620 camcorder rotates up to 90°. The R-620 lists for \$1799.

The 8mm camcorders are also flexible enough to go underwater. Sony has developed two marine packs for its Handycam 8mm camcorders. Both marine packs feature a built-in underwater microphone and a wide-angle conversion lens as well as two accessory shoes



Pivoting viewfinder on Canon's new 8mm camcorders lets you cover all the angles.

for optional underwater lights. One of the marine packs, the MPK-VII, has a built-in 3-in. high-contrast color LCD screen for monitoring the picture while you're taping. An advanced Edit Search feature permits playback of the taped segments while the unit is still underwater. The MPK-VII lists for \$1600 while the second unit, the MPK-F40, lists for \$1200.

While we may venture underwater to shoot a video, our editing is going to be done on dry land. Much of our editing can be done using the camcorder itself. For example, two of RCA's new full-size

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VHS camcorders have editing capabilities normally associated with TV production studios.

Both the RCA CC310 and CC320 pack a variety of features that make editing a videotape pretty simple. They include:

- Flying erase head that eliminates video interference or noise between recorded segments.
- An Audio/Video Dub that allows you to insert new video segments or record a new soundtrack onto the tape.
- A microphone mixing feature that allows you to add narration or new sounds to an audio track already recorded.
- An Edit Search that precisely positions the tape at the start of a new recording.
- A Synchro Edit button which, with



Hitachi's Super VHS camcorder adjusts exposure to give the highest shutter speed.



Philips' Super VHS camcorder is the first with a color LCD viewfinder.

an optional cable, allows you to use the camcorder with a compatible VCR to put together an edited tape of selected scenes.

Another special feature of both of these RCA camcorders is an animation recording capability. With this feature you can animate objects such as toys, dolls or drawings by moving them and then shooting one frame at a time. Playback at normal speed provides the illusion of animation. Time-lapse recording is also available. These features are available singly in many camcorders but when they are packaged together a formidable editing device is created.

The RCA CC320 also includes a titler/character generator as well as 2-speed operation. The CC320 lists for \$1499 while the CC310 lists for \$1399. **PM**



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Firsthand Drive Report

ASC/McLAREN MUSTANG

BY JOE OLDHAM, Editor-In-Chief
PM Photos by Cliff Gromer

A FUNNY thing happens when you drive down the block in an ASC/McLaren convertible. Everybody looks.

Everybody.

In fact, in our entire car-testing life, we can't think of a single car that drew as much attention as this give-me-a-ticket red ASC/McLaren. It happens every time you're in the car. People in other cars speed up next to you to check it out. Then they hang there, blocking traffic while they gawk at you. Park the car anywhere and be prepared for the crowd that gathers around it. Pull into a gas station and be prepared for a question-and-answer period.

"Hey, great car. What is it?"

"It's an ASC/McLaren."

"What, exactly, is an ASC/McLaren?"

"Well, there's this company, ASC, in the Detroit area, that takes Mustangs and chops off the roofs. Then it adds special chassis bracing,

makes it into a 2-seater, customizes the exterior, adds special wheels and . . ."

"Never mind all that. Is it fast?"

The first 25 times this happens, it's flattering. The next 50 times, it begins to wear a bit thin. And after a week, you're happy when you can just drive, park, or gas up and get away with just a nod and a smile of acknowledgement to the admiring stares.

ASC, Inc., is a company that has manufactured special editions before, in conjunction with several car-makers. ASC made the 547 Buick Regal GSXs that we wrote about in the March 1987 issue ("Speed Thrills," page 63). ASC also makes all the 944 convertibles for Porsche. But none of their specials have been as successful, or as popular, as the ASC/McLaren Mustang.

The exterior changes made to the Mustang during the ASC/McLaren conversion are very successful, so much so that only a handful of people recognize the car's origins. Combined with the

(Please turn to page 62)



From all angles, it's unique: clean front end (top), leather interior (above) and smooth profile (below).



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ASC/MCLAREN MUSTANG

(Continued from page 61)

2-seater interior and special appointments, the ASC/McLaren is, especially with the top down, a truly striking automobile.

So it tops the list as a conversation piece. But is it a good car?

Since the car begins life basically as a Mustang GT with its 5.0-liter V8 and either 5-speed manual or 4-speed automatic transmission, you would expect it to be fast. And it is, running from 0 to 60 mph in 7.5 seconds and the quarter-mile in 15.2 seconds at 93 mph in our automatic-equipped test car. But it's not quite as fast as a stock Mustang GT because of the several hundred extra pounds of chassis-stiffening braces, a more complex convertible-top mechanism, and sundry other changes that add weight. Still, it's fast enough to impress most other drivers on the road. And you've got the looks and exclusivity to fall back on when you meet up with the occasional garden-variety Ferrari.

Inside the car, you feel decidedly good. The stock Ford seats are replaced by leather-covered sport seats and the leather extends to the special steering wheel and gear-shift knob. The custom console and other appointments are redolent of the auras and aromas only money can buy.

Handling is a different matter. Here, the ASC/McLaren's origins—the Mustang GT—show up loud and clear. The Mustang GT is one of the most stiffly suspended cars on the road. And therefore, one of the roughest riding on bad roads. The ASC/McLaren suffers from the same malady. It doesn't roll over bumps, it bounds over them, oftentimes literally leaving the pavement for moments at a time. On smooth roads, the ride turns merely firm. And on smooth roads at high speeds, the convertible is solid and secure with precise handling.

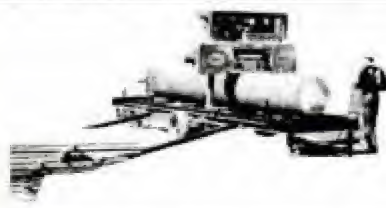
Unfortunately, the world is not all smooth roads. The ASC/McLaren does not enjoy dealing with life's potholes and frost heaves.

But the ASC/McLaren is not about storming back roads in bad weather. No, this is a car that's about sunny days and smooth roads. In the five years ASC has been building the car and selling it through select Ford dealers, it has only made about 2300 of them. So the ASC/McLaren is more exclusive than, say, Ferrari and way more exclusive than a Mercedes-Benz 560SL.

For around \$25,000, then, you can buy yourself what amounts to the ultimate ego trip. If you can stand the attention, here's your next car. **PM**

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Shopsmith Hits The Mark

BY JOSEPH TRUINI, Shop And Tools Editor

HERE'S good news for owners of the Shopsmith Mark V multi-purpose woodworking machine. Shopsmith has just added two new tools to its line of add-on accessories. The tools, a biscuit joiner and a strip sander, will fit both Mark V models 500 and 510.

The biscuit joiner, also known as a plate joiner, provides a quick, easy and accurate way to assemble a wide variety of basic woodworking joints, including the edge-to-edge, edge-to-face and miter joints, to name a few.

The biscuit joiner mounts onto the spindle of the Mark V and consists of a metal housing, 4-in.-dia. carbide-tipped blade, and a spring-loaded fence. Simply push the workpiece against the fence and into the blade to cut a semicircular slot. Then, cut a matching slot in the mating workpiece.

Apply glue to the slots and join the parts with a football-shaped spline, or biscuit. The biscuits are made of compressed beech and come in three sizes: No. 0 ($\frac{3}{4} \times 1\frac{1}{4}$ in.), No. 10 ($\frac{3}{4} \times 2\frac{1}{4}$ in.), and No. 20 ($1 \times 2\frac{1}{4}$ in.).

As the compressed biscuits absorb the glue, they swell and lock in the slots. The biscuit joiner comes with a pushblock and 25 No. 20 biscuits for \$99. Biscuits cost \$9 for 250. Specify size.



Push board against fence of biscuit joiner to cut slot. Joiner mounts to spindle of Mark V tool. Tool is set in the drill press position.



Here's the biscuit joiner removed from the Mark V tool. A 4-in.-dia. blade is concealed behind slot (arrow) in fence.



After cutting slots in workpieces, football-shaped biscuits join boards. Hardwood biscuits are made of compressed beech.

Strip sander

Transform your Mark V into a versatile sander with the addition of a Shopsmith strip sander. A 1-in.-wide \times 42-in. abrasive belt shapes and smooths woods, metal and plastic. It also accepts a $\frac{1}{2}$ -in.-wide belt to sand intricate shapes and fine details.

Install a cloth polishing belt to clean and polish copper, pewter, silver, gold and other metals. It's also a great way to make flatware and

jewelry sparkle like new.

The sander has an 11 \times 11-in. worktable that tilts down 45° and back 5°. Besides sanding bevels and miters, use the tilting table to grind and sharpen chisels and woodturning tools.

Additional features include an adjustable belt-tracking knob, a sawdust collection hookup for a shop vacuum, interchangeable platens and sealed ball-bearing construction.



Narrow-belt strip sander tackles sanding, grinding and polishing chores. Variable-speed of Mark V lets you select belt speed.

The sander comes complete with a 1-in.-wide and $\frac{1}{2}$ -in.-wide platen, $\frac{1}{2}$ -in.-rad. curved platen, two sanding belts and a grinding/sharpening belt for \$169.

Shopsmith sells separately polishing belts and a wide variety of abrasive belts.

For some more details, visit a Shopsmith store near you or write to Shopsmith, 3931 Image Dr., Dayton, OH 45414. **PM**



For internal sanding—smoothing inside a cutout—remove sanding belt from top wheel and pass through cutout in work.



Sander has the upper wheel exposed so that it can be used for contour sanding. Apply light pressure to avoid clogging belt.

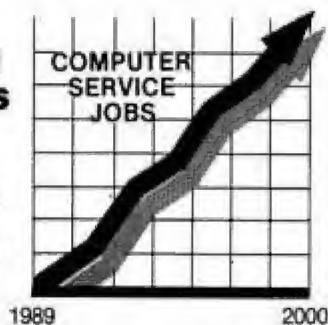
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Jobs for computer service technicians will almost double in the next 10 years, according to the latest Department of Labor projections. For you, that means unlimited opportunities for advancement, a new career, or even a computer service business of your own.

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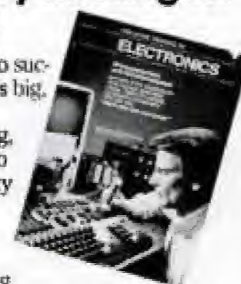


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Better FM Reception

BY FRANK VIZARD, Contributing Editor

FM RADIO offers a smorgasbord of music and entertainment from which we can sample endlessly. New artists, old favorites, different genres, obscure endeavors and commentary on just about everything can be tuned in at will. If an opportunity exists to improve your FM reception, you should seize it immediately.

The best way to improve FM reception is to use a good antenna. Most receivers and tuners come with a large, T-shaped, dipole wire antenna that needs to be extended fully to operate at its full potential. Unless you're very lucky and able to hide it behind a bookcase, you'll have to live with it tacked to the wall in full view. Your inclination will be to not use an antenna at all.

Following your inclination is a definite mistake. Results will vary according to geographic location, but a quick test using a typical hi-fi receiver illustrates the issue. With the dipole antenna hooked up, 38 FM signals were discerned. Without the antenna, only 17 signals could be received.

The dipole antenna, though, is not technology's best answer to FM reception. Recent technology can do better in the looks department as well. Purists may say that an outdoor FM antenna represents the best solution, but many of us require an indoor solution to improve FM performance. Such a solution does exist.

Active circuitry

The manufacturers of quality, indoor FM antennas would like you to think of their products as another component in your audio system. That's not hard to do, considering these products are more effective and more physically imposing than a dipole antenna. They also cost a lot more.

While a number of models are available, two of the newest FM indoor antennas are the LS-4 from Parsec (\$60) and π (that's the Greek letter "pi") by Terk (\$85). Do these products improve FM reception? Most definitely.

The LS-4 and π are made by different companies, but the FM enhancement circuitry in both products is designed by the same man.

Terk's CD-size π antenna fits unobtrusively into room decor.

Larry Schotz is an independent designer/inventor whose name has been associated with FM tuners made by Nakamichi, Proton, NAD, Crown, Sherwood and Tandberg.

Both antennas work similarly in that they use transistors and AC power to amplify and strengthen the FM signal. The trick is to amplify the FM signal while keeping unwanted noise levels low. Larry Schotz succeeds admirably in this regard.

The most obvious difference between the LS-4 and π antennas is their shape. The Parsec LS-4 is a vertically oriented column standing 17½ in. tall. In its vertical position, the LS-4 can receive signals coming from any direction. The LS-4 can also be placed flat for use in a very directional manner in order to receive extremely weak signals. A gain control is included so that you can amplify the signal as needed.

Small, not simple

The Terk π is more unusually shaped, taking the form of a disc not much larger than a compact disc. The π performs as an omnidirectional antenna when laid flat—which means it has a height of about only 1½ in. When arrayed vertically and rotated, the π operates very directionally. Unlike the LS-4, the π doesn't have gain controls. This is a compromise reached with space limitations in mind.

How well the Parsec and Terk antennas work is evident from a hands-on eval-



Parsec's LS-4 FM antenna resembles a modern-art sculpture.

uation, using a receiver's signal-strength meter to compare the relative merits of the Terk, Parsec and standard dipole antennas.

Range and clarity

Both the Parsec LS-4 and the Terk π performed in a manner that was clearly superior to the dipole antenna. Terk's π pulled in nine previously unheard radio stations, and improved the clarity of the 38 already received with a dipole. The Parsec LS-4 delivered a dozen new signals, and significantly improved the signal strength of all the rest. The extra stations and the improved clarity can be attributed to the LS-4's user-adjustable gain control.

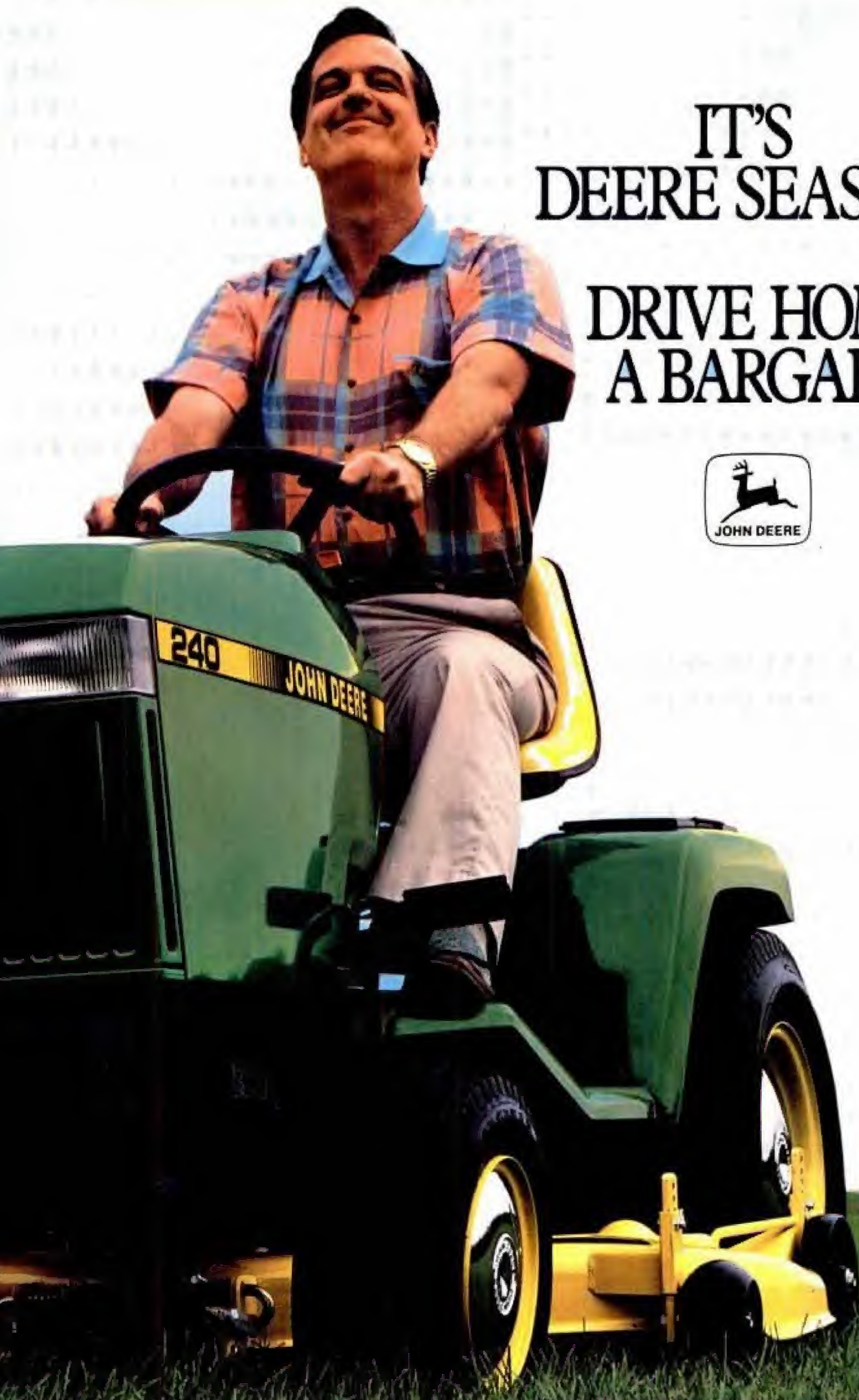
These results will vary from location to location depending upon your proximity to various radio stations. The real point is that both antennas offer a very significant improvement in the quantity and quality of FM reception. The π from Terk is a particularly amazing achievement given its small size. Sheer size and the presence of gain controls seems to give the LS-4 a slight edge in performance. The size difference of the Terk π , however, seems to be a more than acceptable tradeoff.

FM



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Pontiac's Stinger features removable carbon fiber body panels, full-time 4wd and ABS.

Detroit's new-breed concept cars were designed with production in mind.

BY JIM DUNNE, Detroit Editor
PM Photos by Ron Hussey
and G Photo

IF YOU'RE LIKE US, you've probably had a tendency to regard all auto shows as forums for a few tantalizingly sexy shapes that surround nothing more substantial than air. Those shimmering dream machines might suggest performance from another dimension, but rarely does there seem to be much substance to go with the seductive exteriors.

However, the recent North American International

Auto Show (you used to know it as the good old Detroit Auto Show) suggests that a new era is at hand. Instead of the old show ethic—seeing is dreaming—the new Detroit show seems to be saying what you see is what you will soon get.

Detroit is finally stepping up to its long-neglected claim as a world center for automotive design, and the new International Car Show introduced more than a

DODGE VIPER

(all glass panels save for the windshield are removable), and a high-performance 3.0-liter engine are sure attention-getters.

Oldsmobile Aerotech II

Just two years ago Oldsmobile was seriously planning to bring this unusual design to market. But the results of consumer clinics held in tight security showed that the elongated rear compartment with its clam-shell doors was just too radical for a fancy station wagon buyer.

Instead, Olds gets its own all-purpose van, the Silhouette, and a version of the more prosaic S-10 Blazer. Patterned after Olds' closed-course speed record Aerotech single-seater, the new concept model stands just 48 in. high but seats four passengers. Under the hood is a supercharged

dozen new vehicles and engines that will soon be seen on the street. While the displays of top imports from Europe and Japan made the greatly expanded show legitimately international in scope, it was hardware stamped Made in USA that stole the attention of public and industry insiders alike.

It's hard to say why we're seeing this new emphasis on producible show cars. Maybe today's show-goers aren't content to merely dream. Maybe the automakers are just getting smarter. But whatever the reason, we won't have to wait until forever to drive the cars of our dreams. If insider claims are correct, a good many of these cars will show up in our driveways—and sooner than we might think.

Taken from the Detroit show and elsewhere, here are the highlights of the styling and engineering features you can look for in tomorrow's cars.

—specifically, its powertrain—will be in production soon. As for the whole package, that decision is still to be made by Chrysler top management. If it's given the go-ahead soon, Vipers could begin cruising American highways by as early as model year 1992.



OLDSMOBILE AEROTECH II

Dodge Viper roadster is a '60s throw-back for tomorrow with front-mounted V10 engine and rear drive. Olds Aerotech II uses name and supercharged Quad 4 engine of closed-course record car. Buick Essence is all but production-ready, according to division executives. Cadillac Solitaire sedan combines not-quite-ready-for-production technology with an all-new V12 engine.



BUICK ESSENCE

Dodge Viper RT/10

Here's one that could easily be the star of any car show, with its XKE-like front end, Cobra rear and V10 engine. The Viper is classic simplicity personified, with a front-engine/rear-drive chassis and five exhaust headers snaking through a break in the front fender.

The combination of high-tech horsepower and muscular styling can't help but stir the blood of any sports car aficionado, and it's clear that at least some elements of this car

Pontiac Stinger

Sometime in the future and somewhere between an S-10 Blazer and Suzuki Samurai there is a place for a model like this 4-wheel-drive "multi-purpose passenger vehicle." The future in this case is no more than two years away, according to Pontiac insiders.

As for type, call it multifun, and you can't go far wrong. The smoothly rugged advanced styling, 16-in. front tires, 18-in. rears, innovative body



version of the 2.3-liter Quad 4 engine capable of producing 230 horsepower, and of all the Olds Aerotech's many features this is the one that will see production first.

Sprightly little Splash is Ford's fun entry, while Concept 50 could become Mercury's version of Probe. Chrysler Millennium is a rolling safety lab.



FORD SPLASH

sion decides to do with the much-delayed Capri. The Concept 50 rides on a 102.6-in. wheelbase, 3 in. longer than Probe, but has the same overall length—177.4 in.

Mercury officials claim the car could be built with a V6 engine and all-wheel drive, which would certainly set it apart from its Ford cousin. De-



MERCURY CONCEPT 50

Buick Essence

It doesn't take a design specialist to see that the Essence is virtually production-ready as it stands. GM officials readily admit that the Essence is a car that, with little change, will be on the market within three years.

Essence is definitely slated to be a luxury sedan that will be the flagship of Buick's full-size sedans. A 185-hp version of the GM 3.8-liter V6 provides power to the front wheels through a beefed up version of GM's THM440 4-speed automatic.

With an overall length of 210.1 in., Essence is over a foot longer than today's biggest Buick. Wheelbase is 3 in. longer, at 113.8 in. Could this be the car that Buick will use to resurrect the Roadmaster nameplate?

Ford Splash

Described by some as a grounded flying saucer, the Splash isn't as frivolous as it looks. Automakers are going into the fun car realm in a big way, and the Splash, with provisions for all-wheel drive and ad-



CHRYSLER MILLENNIUM

justable suspension, is just one of several that turned up in Detroit.

Overall length is a tidy 143 in., on a 93-in. wheelbase. According to Ford, the Splash will lend itself to all sorts of sports-oriented pastimes, becoming "a scuba, ski or surfing vehicle, a sports car or even a weekend snow skiing" getaway machine, as the driver wishes.

Mercury Concept 50

Mercury could turn out this Ford Probe clone in a matter of months, but you won't see it in any showrooms that soon, depending on what the divi-

sign distinctions include a rear hatch designed into a notchback shape and exhaust outlets fared into the rear bumper.

Chrysler Millennium

Billed as a safety car of the future, Millennium offers an unusual combination of advanced exterior styling and innovative chassis. Among its safety features: Active suspension for better control over all types of terrain and surfaces, traction control, anti-submarine seats that hold passengers in place during crashes, rain-sensitive wipers, blind-spot radar, collision alert, air bags and infrared vision for low-visibility driving.

The 4-door sedan is midrange in



CADILLAC SOLITAIRE



**CHEVROLET
CAMARO IROC-Z**



**PLYMOUTH
SPEEDSTER**

Camaro IROC-Z debuted in California and is expected to reach production almost as-is. Plymouth Speedster is washable inside and out. Jeep Cherokee Aero differs from future production model only in lower body trim.

The inside is a molded plastic tub decorated with "wet suit" upholstery and movable plastic controls that can be hosed out when you're washing the outside. The Speedster shown at Detroit used a 4-cylinder motorcycle engine mounted behind the rear seats and driving the rear wheels.

The car is tiny. Overall length is 130.2 in., a foot shorter than the Suzuki Sidekick, while the wheelbase is a puddle-jumping 82 in.

Jeep Concept I

Based on the current Cherokee, the Concept I is a thinly disguised look at the real Cherokee for 1991. Take away the oversize bumper/grille and you have what Jeep will offer alongside the Cherokee as a premium model.

Insiders look for Dodge dealers to have their own version of this vehicle. Styling highlights not readily apparent are 17-in. cast alloy wheels and lower body cladding all around.

One secret this show special lets out of the bag: The future Cherokee will be 10 in. longer at 175.9 in. and ride on a wheelbase that's 5.5 in. longer than today's 105.9 in. The added length will allow wider doors for both front and rear passengers, as well as more interior volume.

PM

size, with a length of 194.7 in., but near the class of a limousine in wheelbase with a span of 122 in. Chrysler claims the Millennium is an evolutionary update on its Lamborghini Portofino show car of a year earlier. Its safety equipment will probably be introduced piecemeal in future Chrysler models, while the exterior design is said to be a portent of early '90s Chrysler products.

Cadillac Solitaire

Cadillac built its first concept car, a single-cylinder coupe, in 1905. It was used to examine the feasibility of building an enclosed car body. A year later the car, called the Osceola, was in production.

Solitaire won't get into production quite that soon, but many of its features are surely slated to show up by the mid-1990s. The long, sloping hood and eggcrate grille are slated for Eldorados and Seattles in two years, while its all-aluminum V12 engine may very well be ready for a next-generation Allante, which is expected to come along in 1995.

The Lotus-designed V12 is rated at 430 hp, from 6.6 liters (401 cu. in.).

There are no mirrors on the Solitaire, inside or out—video cameras are assigned to the rearview duty. Solitaire's doors are the longest ever made at GM. They swing out and forward on special hinge arms that allow easy

entrance to the passenger compartment, without requiring excessive space around the vehicle to do so.

Chevrolet Camaro

You will see this IROC Camaro on the street in less than three years. That's a promise from Chevy insiders, who claim that the concept car and Pontiac's Banshee show car will be little changed between here and production.

Dramatic styling isn't the only feature to watch for. Powerful dohc V6 and V8 engines, rear-wheel drive and a rugged chassis updated from today's car are also part of the plan.

Compared with today's Camaro, the wheelbase will be 3 in. longer (at 104 in.), but length has been reduced by nearly 6 in. to 186.4 in.

Plymouth Speedster

If you're in the 18-to-25 age range and like the combination of sports cars and motorcycles, the Speedster from Plymouth should be right up your alley—or maybe even in your garage.



**JEEP
CONCEPT I**

March 1989
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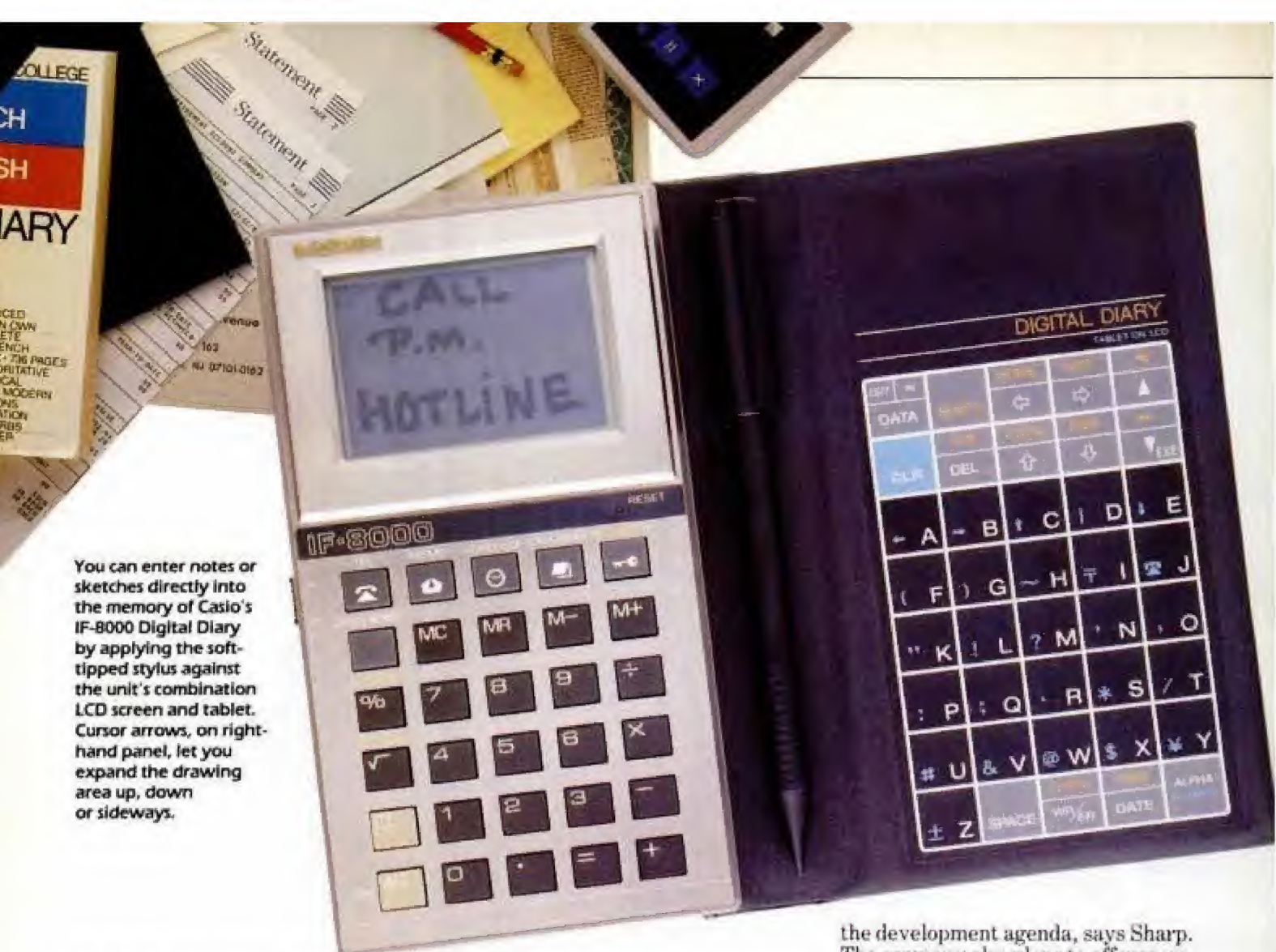
DIGITAL DIARIES

The "little black book" needs batteries now as portable, computerized electronic notebooks pack a mountain of paper in your shirt pocket.

BY FRANK VIZARD, Contributing Editor

THERE'S a saying about having the whole world in the palm of your hand. Well, the world may not fit into the palm of your hand, literally, but just about everything you need to know about it now can be stored in a pocket-size electronic device that is easily gripped by even the smallest fingers.

What look like a bunch of fancy pocket calculators are really the first of what may be called personalized computers. At the forefront of this developing technology are companies such as Sharp, Psion and Casio—and a multitude of other companies have designs. The most advanced of their "digital diaries" can exchange data with full-



You can enter notes or sketches directly into the memory of Casio's IF-8000 Digital Diary by applying the soft-tipped stylus against the unit's combination LCD screen and tablet. Cursor arrows, on right-hand panel, let you expand the drawing area up, down or sideways.

fledged computers. But even machines lacking the ability to interface with other computers can provide you with a library of information at the touch of a button.

The appeal of machines like the Sharp Wizard, Psion Organiser II, and the Casio Digital Diary lies in their smallness. Moreover, these handheld devices are simpler to use than regular computers, thereby giving users a comfortable level of psychological control. Unlike personal computers and the varied software they use to perform a variety of functions, "pocket smart" devices are uncomplicated. Learning to operate them is like driving a car: Once you can drive one car, you can generally drive them all.

Wiz Kid

The Sharp Wizard (\$300) is the newest piece of pocket smarts available. The Wizard (shown on the preceding page with its thesaurus/dictionary and travel/language translator cards) packs an appointment diary, calendar, phone directory, world clock and a notepad into a 4 x 6-in. package weighing just 8 ounces. The 32KB (kilobytes) memory is roughly

the equivalent of 16 pages of double-spaced typed text.

These are just the built-in functions, though. The Wizard unfolds like the sweep of Merlin's arm to reveal a keyboard on the right and a display screen on the left. The liquid-crystal display screen presents information in a 16-character x 8-line or 10-character x 4-line configuration for easy reading. But below the display screen is a card port that is the key to the Wizard's power.

Sharp has developed several integrated circuit software cards that slide into the card port and turn the general-purpose Wizard into a specialized machine. Slide in the credit-card-size dictionary/thesaurus programs for example, and you will have access to an 87,000-word base derived from the *American Heritage* dictionary and a thesaurus with 500,000 synonyms listed under 42,000 headings.

Other cards available include a time-management system for organizing your work load, an 8-language translator, and a program for expense account reporting. Additional cards dedicated to finance, science, travel—even games and wine lists—are on

the development agenda, says Sharp. The company also plans to offer memory expansion cards that will store data like blank floppy disks. Card prices will vary. The dictionary/thesaurus card costs \$130, for instance, while the language translator card lists for \$100.

The Wizard can communicate with others of its kind, and with personal computers, through an RS-232 connector jack concealed in the top of the machine. The Wizard also can be connected to a printer and a cassette player available from Sharp. A communications card that will allow the Wizard to interface with fax machines, paging devices and similar communications tools is in the works. The printer lists for \$170. Prices on the other accessories are not yet available.

All of the data stored in the Wizard can be protected by a secret code known only to you. Backup batteries to the Wizard's two lithium batteries ensure continuous operation and prevent memory loss for up to two years.

Pocket computer

Psion Organiser II is similar in concept to Sharp's Wizard, although there are differences in methodology. The Psion Organiser II (\$250) weighs

in at 9 ounces and measures 5.6×3 in., but at 1.1 in. is slightly thicker than the Wizard.

The Organiser II's display screen is always visible at the top of the machine like a wide robotic eye. Invisible until you slide down its protective case is the unit's 36-button keyboard. Like a typewriter, each key has a dual function when the SHIFT button is engaged.

From an operating standpoint, the Psion Organiser II has the look and feel of a computer. The machine has its own programming language, called OPL, that allows you to customize the Organiser II to a specific task, no matter how esoteric. Like the Wizard, the Organiser II can swap data with a computer through the use of an optional connector.

The Organiser II offers calculator, calendar and diary functions in addition to 32KB of programmable memory. Over 200 entries are possible, with each entry a maximum of 16 lines or 256-characters long. Information is presented two lines at a time on the display screen.

The key to the Organiser II's versatility is the variety of Datapaks that plug into two ports located on the side of the machine. Datapaks covering finance, travel, math and spelling are among the specialty items available. Like the Wizard IC cards, Datapaks vary in price, ranging from a low of \$50 for wordprocessing, financial and spelling programs to a high of \$130 for a travel Datapak that includes a language translator.

More important, perhaps, is the availability of Datapaks that increase the Organiser II's built-in memory. Extra memory is available in 16KB, 32KB, 64KB and 128KB sizes listing for \$30, \$50, \$90 and \$150, respectively. Separate Datapaks can then be used for different subjects of your own choosing.

Datapaks do differ from the Organiser II's built-in memory, however. When information is entered into the Organiser II's memory it can be erased when you choose. This isn't true of Datapaks: Information entered into a Datapak cannot be erased easily. To clear and reuse a Datapak you need what Psion calls a formatter—a machine that clears the Datapak by controlled exposure to ultraviolet light. The Psion formatter lists for \$80.

Psion offers a number of other accessories to maximize the Organiser II's flexibility. These accessories include a printer, a laser scanner, a bar code reader, telephone modem and a variety of appropriate adapters and cables. There's also an optional 110-

volt AC adapter to supplement the unit's 9-volt battery. A separate programming guide is also available from the company.

The write stuff

Casio, the electronics firm that coined the term digital diary, offers several products that perform functions similar to those of the Wizard and the Organiser II. But the company's IF-8000 Digital Diary (\$180) provides a feature that is entirely unique: It lets you write or draw by hand, just the way you would with pencil and paper.

This graphic capability makes up for the Digital Diary's short memory—just 15,328 characters, about half the Wizard's capacity. The memory isn't expandable, nor can the IF-8000 interface with computers. But it is lighter and slimmer than Sharp's or Psion's entry, weighing in at 7 ounces and measuring $5\frac{1}{2} \times 3\frac{1}{2}$ in. Similarly to the Wizard, the IF-8000 interface opens like a little book, and at first glance appears to be two separate machines.

On the left side is the liquid-crystal display area and a numerical keyboard that contains several function buttons. The LCD screen presents a 16-column, 8-line information display. The function buttons access the telephone directory, memo, schedule and calendar modes. There's also a button to be used for entering a secret code if you want to keep your data away from prying eyes. When the Digital Diary is turned on, it automatically enters the calculator mode.

On the right side is another, thinner keyboard that appears to be no more substantial than a flap, but it is this flap that gives the Digital Diary its special characteristics.

In a word, the Digital Diary allows you to write or draw. Data can be entered

using the keyboards, but by using the supplied pen, data such as maps, sketches and diagrams can be stored as well.

As you move the pen over the touch-sensitive screen, it touches a grid of tiny squares that turn black upon contact. Drawings can be made with thick or thin lines. Lines can also be erased.

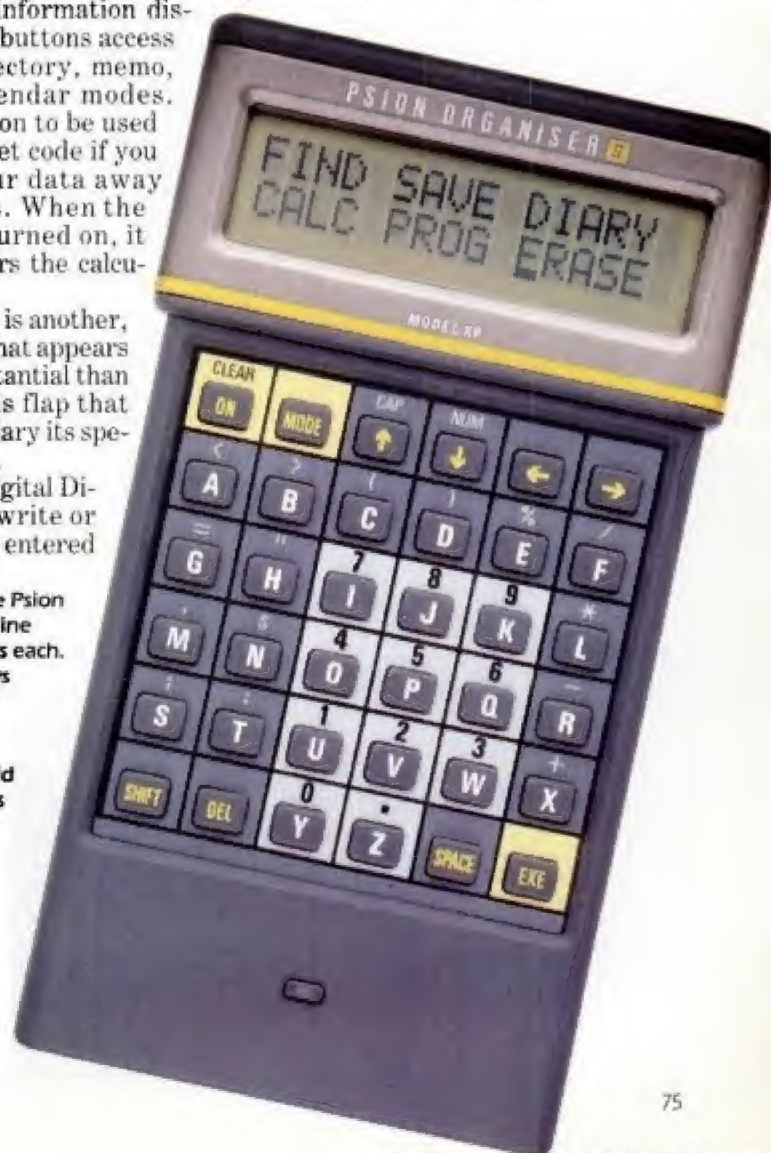
An expanded screen size function allows you to draw a map, for example, the size of four screens. All you do is scroll up, down, right or left to view the desired portion of the map.

The Casio Digital Diary, Sharp Wizard and Psion Organiser II are representative of the type of pocket smarts that have universal applications. Besides these, there is a large selection of dedicated devices that perform specialized functions.

For example, several manufacturers offer credit-card size memory devices for storing telephone numbers. The same is true for devices that will check the proper spelling of a word.

You can learn a lot about people by what they carry around in their pockets, as the old saying goes. Anyone carrying a piece of pocket smarts will give someone a lot to learn. **PM**

The LCD readout of the Psion Organiser II offers a 2-line display of 16 characters each. Using the cursor arrows at the top right of the panel, you can access any of the unit's many functions. The handheld unit also communicates with most desktop computers.



COMPARISON TEST

OFFSHORE

Five 20-ft. center-console wavebusters battle each other and the fish in our latest confrontation.

BY JOE SKORUPA, Boating/Outdoors Editor; PM Photos by Brian King


FLORIDA SUNSHINE pours through holes in a convoy of clouds that marches in loose formation overhead. Driven by an offshore storm, lighter-than-air squadrons pass in front of the Sun and switch it on and off like a light bulb. At times, they pelt us with rain. The wind, however, is constant and whips up whitecaps and a relentless 3-ft. chop.

I'm in the middle of this weather system on a high-speed, round-trip run from the southern tip of Elliott Key to Key Biscayne, a distance of more than 40 miles. As I blast through rollers stacked up in bluewater channels, and scream over sand bars covered by only a breath of water, I marvel at the versatility of this gutsy center-console boat. At 40-plus mph, the 20-footer launches regularly, but lands softly on the stern. Salt spray flies well away from the driver. (Incidentally, I completed the 40-mile run, including down time for refueling and buying supplies, in 80 minutes.)

The PM test team brought together five of these wavebusters, equipped with 200-hp Johnson outboards, for a comparison test and to see how rugged they really are. In addition to long runs in Biscayne Bay, we blasted out of Government Cut to hang out in one of North America's tougher neighborhoods—the Gulf Stream. For three days we used our radar gun, stopwatch and measuring tape to put the fleet through a battery of tests. Here's what we found.

Grady-White 204 Fisherman

Three contenders finished the test in a virtual tie for top honors. Yet a test winner emerged because each boat had a distinctive character and philosophy of design. Although craftsmanship and performance levels were similar for the top three, the Grady-White 204 Fisherman could not be denied the test-winner's crown.



Heading for open sea (from left to right): Boston Whaler Outrage 20, Pursuit 2100 Center Console, Grady-White 204 Fisherman, Wellcraft 20 Fish and Stratos 200 CC.

SHOWDOWN





WELLCRAFT 20 FISH

The 204 Fisherman was the fleet leader in hull performance, with firsts in acceleration and performance course time. It was a close second in top-end speed.

Fit and finish was also outstanding (tied for first). Craftsman-like touches include through-bolted hinges, heavy-duty bow rail, rub rail and cleats, built-in tackle box and ice chest, and 10 rod holders. Certain elements could be improved, such as stowage space (fleet's smallest) and bulky console. But hull reentry was among the best, just not as smooth as in other Grady-White models.

Still, for overall fishability, seaworthiness and fishfighting design, the 204 Fisherman is second to none.

Boston Whaler Outrage 20

No boat in the fleet is better built than the Outrage 20, which virtually tied the Grady-White in overall excellence. But two elements kept it back from the top spot—higher price and minimalist center console.

Performance was outstanding, with first-place ranking in top-end speed and second in hole shot and performance course time. It clearly pulled away from the pack, however, in the open sea. Hull reentry and spray deflection were sensational.

Fit and finish, as mentioned, are peerless. Features of note are welded stainless-steel bow rail, heavy-duty

cleats, thick rub rail, 10 holders for rods and through-bolted hinges.

No doubt, the small center console is intentional, as is the lifting eye in forward deck area (for use as a yacht tender). But the small console allows minimal space for stowage and electronics. In addition, the windscreen was too low to protect driver's eyes during a rainstorm.

The Outrage 20 sports the fleet's highest price tag, but maintains its value for future resale due to a 10-year transferable hull warranty that diminishes the initial sting.

Pursuit 2100 CC

This boat has so many good qualities that it, too, virtually tied for the top spot. It was easily the fleet's most consistent finisher, with firsts in usable deck area and console design (tied) and seconds in fishability, fit and finish and stowage.

Middle of the pack top-end, hole shot and performance course results, however, kept it from a higher overall finish. The 2100's big-boat feel, however, which made it seem sluggish, served it well in the open ocean. Dryness and hull reentry were superb.

Equally sensational is the center

TEST PARAMETERS

Each boat was propped and tuned by technicians from Johnson. Speed and timing data were collected in Biscayne Bay. They are the result of averaging four test runs in protected water for each boat with two adults aboard and matched fuel loads. Performance course, which began from a dead stop, was a 1/8-mile figure eight. Seaworthiness was judged by performance in the Atlantic Ocean.



OVERALL RANKING/MAKE/MODEL	1. GRADY-WHITE 204 FISHERMAN	2. BOSTON WHALER OUTRAGE 20
LOA/Beam/Weight/Fuel Capacity	20'4"/96"/2245 lb./80 gal.	20'3"/89"/1850 lb./77 gal.
Top End (mph)/Ranking	50.63/2, a fraction from the leaders	50.75/1 (tied), wants to fly
Acceleration 0-40 mph (sec.)/Ranking	9.16/1, sets a blistering pace	9.42/2, leaps up on plane
Performance Course (sec.)/Ranking	34.49/1, handles like a roadster	34.81/2, stable, predictable, responsive
Fishfighting Space (sq. ft.)/Ranking	91.47/2, excellent with 26" freeboard depth	85.48/3, roomy due to small console
Stowage Space (cu. ft.)/Ranking	27.16/5, adequate, but smallest in fleet	27.18/4, sufficient, but opportunities missed
Console Design/Ranking	Spacious, but bulky and no footholds/3 (tied)	Fleet's smallest, windscreen too low to protect/4
Fishability/Ranking	Small fish and bait wells, otherwise superb/3	Outstanding seaworthiness, many rod holders/1
Fit And Finish/Ranking	Craftsman-like attention to detail/1 (tied)	Uncompromising quality throughout/1 (tied)
Price As Tested	\$13,125	\$17,395
Address	Grady-White Boats, P.O. Box 1527, Greenville, NC 27835, (919) 752-2111	Boston Whaler, 1149 Hingham St., Rockland, MA 02370, (617) 871-1400

Fleet equipped with Johnson 200-hp, V6s (about \$8000), which have variable-ratio oil injection, overrev limiter.



Instruments and controls have optimum positioning due to abundance of room on tail, bulky console that is too much of a good thing.



Although console "floats" and has fleet's only safety light, gauges are overlapped by wheel because of tight quarters on small unit.



console, which in this case floats above the deck and allows toe room for extra support. The large unit has plenty of space for stowage and electronics. Integrated ice chest and tackle box are also standard.

Among many outstanding features are thick rub rail, 14 rod holders, substantial cleats, hawsepipes aft, through-bolted hinges and heavy-duty welded stainless-steel bow rails.

Wellcraft 20 Fish

The greatest strength of the 20 Fish is economy, sporting the fleet's lowest price tag. First-place rankings in top-end speed (tied) and stowage space, second in console design and third in performance course time are other areas of strength.

Despite these impressive marks, the 20 Fish finished back of pack in the remaining categories and well behind the overall fleet leaders.

The floating console, similar to the one on the Pursuit, is a superb choice. Others include a swim step, boarding ladder and built-in cutting board.

Latches that rattle unmercifully are examples of less successful choices. Others are hatch doors that open while underway, surface-



GRADY-WHITE 204 FISHERMAN

mounted (as opposed to through-bolted) hinges, thin rub rail, light bow rail and cleats, few rod holders and decal striping that swiftly rubs off.

Offshore, the hull pounded in rollers and was wetter than most, but, as mentioned, the price is right.

Stratos 200 CC

Numbers don't tell the whole story of the Stratos 200 CC, built by a company renowned for freshwater rigs. Back-of-pack rankings kept it off the pace of pricier boats, but since it comes as a package deal, with boat, motor, trailer and depthfinder for less than \$21,000, it may well lead the fleet in overall value.

Certain fit and finish decisions are

problematic, such as decal striping that pulls away from hull and surface-mounted hinges and hardware. Others are outstanding, such as heavy-duty bow rail, recessed aft cleats, 16 holders for rods and teak toe rails.

Offshore, the Stratos was relatively dry, but pounded somewhat. The console, with integrated rod holders and superb space for electronics and stowage, is among the best.

The tightness of the test fleet's rankings—divided by design philosophy into upscale and value-priced tiers—shows that modern offshore fishermen are well served by versatile and rugged boats that are perfectly at home in the Gulf Stream alongside vessels twice their size. **PM**



3. PURSUIT 2100 CENTER CONSOLE

20'6"/96"/2500 lb./86 gal.

50.25/3, held its own in fast fleet

10.26/3, more than enough zip

37.31/4, big-boat feel in turns

94.46/1, copious, with a deep 26" high freeboard

42.97/2, huge space in anchor locker and console

Floating design, built-in tackle box, rod holders/1

Excellent in bluewater, large fish and bait wells/2

Superb, but much teak for low-maintenance rig/2

\$12,290

S2 Yachts, 725 E. 40th St., Holland, MI 49423, (616) 392-7163

4. WELLCRAFT 20 FISH

20'6"/96"/2140 lb./60 gal.

50.75/1 (tied), sprints like a runabout

12.79/5, well behind fleet

36.21/3, sure cornering, no misbehavior

82.11/4, adequate open areas, but 22" freeboard

53.18/1, huge compartments for gear and fish

Outstanding floating design and space below/2

Somewhat rough ocean ride, few rod holders/5

Lacks through-bolt hinges, latches failed to hold/4

\$9845

Wellcraft Marine, 1651 Whitfield Ave., Sarasota, FL 34243, (813) 751-7800

5. STRATOS 200 CC

19'10"/98"/2000 lb./84 gal.

48.88/4, fast enough in big water

11.53/4, adequate but somewhat sluggish

37.40/5, handled well but without spirit

79.09/5, sufficient for fleet's smallest boat

39.56/3, immense spaces in useful layout

Footholds would improve superior design/3 (tied)

Offshore ride a bit rough, but superb fish/bait wells/4

Welcome exceptions to overall economy approach/3

\$9938*

Stratos Boats, 931 Industrial Rd., Old Hickory, TN 37138, (615) 847-4034

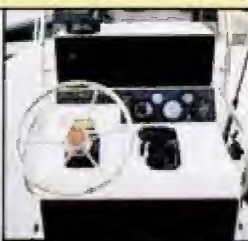
Console sets fleet standard with high-mounted, plexiglass-covered gauges, space for adding instruments and large stowage below.



Exceptional placement of gauges and controls and spaces for add-ons demonstrate functionality of one of the best console's in the fleet.



Off-center gauges offer clear sight-lines. Note in-dash depth flasher on far right. Wind-screen ideal height for visibility, protection.



MOTORCYCLES

TOURING

First Class

On the open road with the heavyweights of luxury motorcycling.

BY NORMAN S. MAYERSOHN, Contributing Editor
PM Photos by Ron Hussey and Humphrey Sutton

NO DOUBT ABOUT IT, if you're a touring rider today, you *can* take it with you—all of it: cruise control, sonic-boom stereo, trip computer, a luggage-carrying volume equal to a Manhattan apartment, even 6-cylinder power and reverse gear. And that's just what we did with a half-dozen examples of motorcycling's alternative to the 34-ft. Winnebago. This is first-cabin motorcycle touring and self-sacrifice will not be necessary.

As the miles clicked off, the members of this touring armada—better than \$50,000 worth of cycles—revealed their highly individual personality traits. The range of

mechanical sophistication, from incredible complexity to seemingly anachronistic engineering, raises questions which are best answered only after you've put a couple of days of riding between yourself and home.

While the route chosen for our evaluation gifted us with the exhilaration of breathtaking Shenandoah Mountain switchbacks, it also extracted a payback in the form of miles of urban commuter crawl. And though the skies smiled upon much of our passing, dramatic downpours and bone-chilling evenings rounded out the experience with a slice-of-life reality factor. Under these conditions, the effectiveness of design approaches offered by manufactur-



Honda's 1500-cc 6-cylinder Gold Wing hits the road with Kawasaki Voyager XII ahead and Suzuki Cavalcade in the lead. Elaborate, high-tech instrument panel probably deserves to be called a dashboard.

PM PHOTO BY RON HUSSEY

TOURING FIRST CLASS

ers on three continents clearly illustrated each one's strong points and weak spots.

BMW K100LT

The touring versions of the BMW 4-cylinder model range are certain proof that riding conditions on the European continent share little similarity with America's endless vistas and tight speed limits. Fully equipped in every respect, the K100 is still lean and purposeful compared to the opulent land yachts from Japan.

BMW's full-boat tourer for '89 is the K100LT, which was not available at the time of our test. We rode a fully optioned '88 K100RT, mechanically the same except for minor trim items—and the ABS braking system. ABS is standard on the LT (accounting for most of the \$2000 price difference

above the now-discontinued RT), putting it at a breathtaking \$12,295.

Unlike its Japanese counterparts, the BMW has not been developed solely for American-style touring, but is derived from the versatile range of K-series bikes. This family of machines uses a liquid-cooled, 987-cc inline Four laid over on its side, cams to the left and crankshaft to the right. Bosch LE-Jetronic fuel injection offers refinement found on no other motorcycle brand, and smooth power delivery. Like all BMWs from the beginning of time, it is shaft-driven.

The BMW is long on intelligent design features, with quick-detach saddlebags, a sidestand retractor actuated by the clutch lever and a useful LCD gear posi-

tion indicator. We found ourselves checking it frequently, as the engine's natural vibration period is intrusive at prime highway cruising speed. The buzz fades away as speed increases and disappears altogether by 75 or 80.

Harley-Davidson FXRT Sport Glide

For many years, heavyweight touring meant Harley-Davidson and nothing less. That's still true for a vast number of riders. Their luxury liners come from the FL Electra Glide series. For our evaluation, an FX-series bike was chosen as being more compa-

rable to the other machines. In the Milwaukee scheme of things, this is a sportier alternative—the same 1340-cc V-Twin engine and Gates belt final drive into a lighter chassis.

In every way the FXRT is the most basic motorcycle in this

group. It uses a frame-mounted fairing, but has virtually no weather shielding for the lower body. The engine is air cooled and uses pushrods to actuate the valves. Where most of the competition has microprocessor-controlled self-canceling turn signals, the Harley rider must do the blinking himself.

There's nothing wrong with simplicity, as proven by our fix of a broken battery cable that might not have been possible on the other bikes. But for its price, the details suffer badly. The saddlebag latches are chintzy, cruise control amounts to a primitive thumbscrew bearing down on the hand throttle and the general fit and



SPECIFICATIONS AND DIMENSIONS

MANUFACTURER/ MODEL	PRICE (LIST AND AS TESTED)	ENGINE TYPE AND DISPLACEMENT (ci/cc)	ENGINE HP, NET/TORQUE (lb.-ft.)
BMW K100RT	\$12,295*	L4, DOHC, 60.2/987	82 @ 8000 rpm/64 @ 6000 rpm
Harley-Davidson FXRT Sport Glide	\$9621	V-twin OHV, 81.7/1340	68 @ 5000 rpm/82 @ 3600 rpm
Honda Gold Wing GL1500/6	\$11,498	Opposed 6, SOHC, 92.7/1520	95 @ 5000 rpm/104 @ 4000 rpm
Kawasaki Voyager XII	\$8699	L4, DOHC 16-valve, 73.1/1196	97 @ 7000 rpm/80 @ 5000 rpm
Suzuki Cavalcade	\$9999	V4, DOHC 16-valve, 82.9/1360	90 hp, estimated**/82 @ 5000 rpm
Yamaha Venture Royale	\$9799	V4, DOHC 16-valve, 79.0/1294	90 hp, estimated**/87 @ 5000 rpm

*Price for 1989 K100LT with ABS brakes



**HONDA GOLD WING
GL1500/6**

finish is less than you'd hope for in this class. The air cleaner demands an unnatural curve in your right leg and the engine cases threaten to fry your boots.

Still, the Sport Glide has bankable strong points. The torquey engine willingly delivers power at low rpm, and does it with a distinctive rumble. The thin waistline makes the bike feel far lighter than the scales indicate and the belt drive system is sensible, straightforward engineering.

Honda Gold Wing GL1500/6

Honda, the company that defined modern luxury touring with the original Gold Wing back in 1975, has taken the state of the art to the next generation. Facing an onslaught of newer, better handling machines from the competition, Honda responded with an all-new 6-cylinder motorcycle which comes closer than ever to being a 2-wheeled version of the Accord.

Like a car, the GL1500/6 conceals virtually all of its mechanical workings in sleek bodywork. Of the engine,

only the cam covers are visible. Even the front disc brakes are tucked under a stylish housing. Honda's vast experience with the touring lifestyle shows through: The radio knobs are easily operated by gloved hands and an effective ventilation system provides the choice of cool breeze or engine-heated air on the rider. The enormous saddlebags open wide for easy

loading and feature a convenient central locking system.

At 880 pounds fully gassed, the GL1500/6 could have been a real handful at low speeds, but parking lot crawls are tolerable thanks to a low seat height and center of gravity.

Backing all that machinery out of a tight parking spot doesn't demand a lot of muscle, as a starter motor-operated reverse gear will do the hard work at a controllable 1 mph. Clever engineering also delivered a centerstand which requires no grunting, and even if it gets away from you, the bike won't tip over entirely, thanks to guards positioned under the saddlebags.

As you'd expect, the Six delivers its 95 horsepower (at only 5000 rpm!) with uncanny smoothness, but the unbelievable silence must be experienced. The Gold Wing's fairing provides a large still-air pocket for the rider, virtually eliminating wind noise and buffeting. If you must find details to niggle over, point at the complications to roadside repair re-

sulting from the integrated bodywork. Gas mileage is poor at 40 mpg by our testing. We also experienced a couple of instances of the rear tire stepping out of line in hard cornering.

Kawasaki Voyager XII

Not so long ago the inline Four was the most common of big bike powerplant configurations. But among touring rigs, only the Kawasaki uses one today, an 1196-cc dohc 16-valver that shares more than a little with the Ninja.

Though the Kawasaki makes a massive visual statement, it is in fact the lightest of the full-dress touring bikes from Japanese companies at 775 pounds. That helps to make it the quickest of this pack as well as one of the most fuel efficient. It's also the second smoothest machine (behind the Honda), thanks to dual counterbalancers and rubber engine mounts.

Rider comforts abound. The sound system functions well, thanks to four speakers and automatic volume compensation, though low power output

(Please turn to page 150)



**SUZUKI
CAVALCADE**



KAWASAKI VOYAGER XII



SUZUKI CAVALCADE



YAMAHA VENTURE ROYALE

				TEST RESULTS	
WHEELBASE (in./mm)	LENGTH OVERALL (in./mm)	CURB WEIGHT (lbs.)	FUEL CAPACITY (gal.)	FUEL ECONOMY (MPG test)	ACCELERATION 1/4-MILE (sec. @ mph)
59.7/1516	87.4/2220	622	5.8	54	13.81 @ 95.94
61.3/1557	94.2/2393	655	4.2	43	15.09 @ 85.47
66.9/1699	103.5/2629	880	6.3	40	14.12 @ 92.21
63.7/1620	99.2/2520	772	6.1	48	13.72 @ 98.90
65.7/1670	99.6/2530	870	6.1	36	14.01 @ 94.33
63.4/1610	100.0/2540	813	5.3	48	13.76 @ 97.61

**Manufacturer does not publish specific horsepower numbers.

EXCLUSIVE REPORT

RED TECH

Despite severe shortcomings, the Soviet Union is showing the West new ways to master key technologies.

BY TIM COLE, Science/Technology/Aerospace Editor
PM Photos by Brian R. Wolff

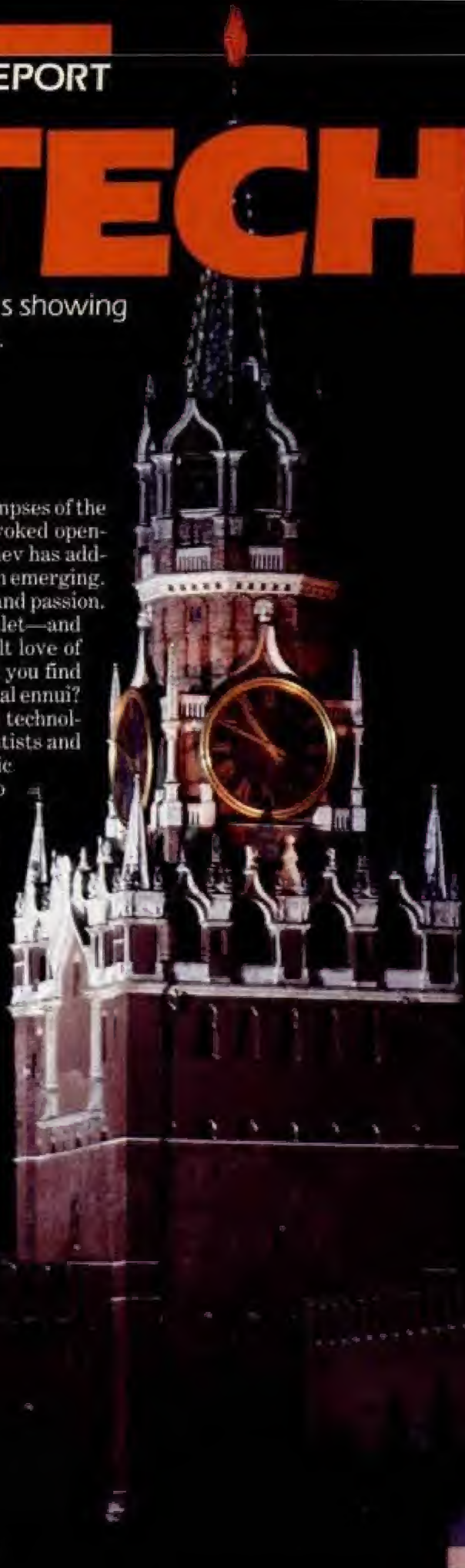
UP UNTIL NOW, a monolith of gray has met Western glimpses of the Soviet experience. But in the past two years, the oft-evoked openness, or *glasnost*, of General Secretary Mikhail Gorbachev has added shades of light and dark to the still uncertain picture of a nation emerging.

A lingering paradox characterizes this immense land of pride and passion. What other country on Earth can produce such breathtaking ballet—and such lockstep conformity? Where else do you find such heartfelt love of land—and such devastating ecological damage? Where else can you find so many spirited individuals—amid such an all-consuming national ennui?

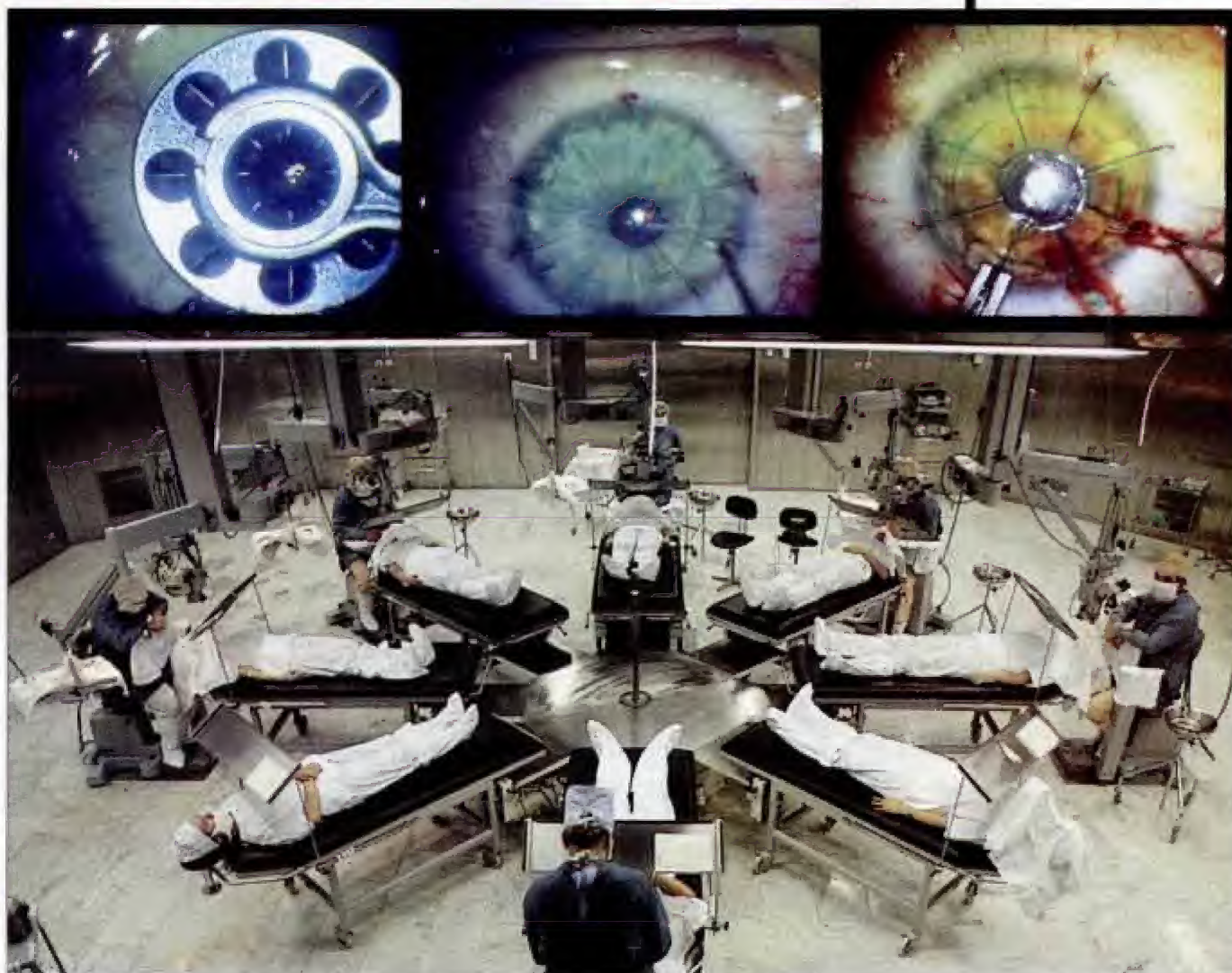
This kind of ambiguity also colors the U.S.S.R.'s science and technology efforts. Where else can you find so many high-ranking scientists and so few Nobel prizes; such world-beating efforts in space and public transport and such astonishingly meager computing power; so many great scientific minds and so little broad-based benefit?

The failures of Soviet science and technology deserve further analysis. But the lapses also serve to spotlight the U.S.S.R.'s truly notable strengths—in space, where Soviet cosmonauts have logged countless hours; in medicine, where economic imperatives have fostered revolutionary surgical techniques; in particle physics, where world-class theoreticians strive to unlock the secrets of the universe.

POPULAR MECHANICS ventured to Soviet technology centers last fall to produce this firsthand report. Along the way we encountered an unexpected diversity—from the forbidding mists of Red Square during nighttime military maneuvers, to the high-tech transformation of the Siberian steppes. Along the way we discovered flashes of brilliance illuminating a Soviet future emerging, however gradually, from once-impenetrable shadows.



RISING



Aye for an eye

Wide boulevards radiating from the center of Moscow connect the medieval splendor of the Kremlin with vast housing tracts in outlying suburbs. In this respect, the teeming roadways link past with present—or past with future if you consider Moscow's Eye Microsurgery Complex, where Dr. Svyatoslav Fyodorov has fashioned an innovative surgery technique that borrows from Henry Ford's automotive assembly line.

A team of specialists—using high-powered optics linked to video monitors—can simultaneously treat eight patients for common vision disorders. The patients are shuttled on and off a revolving assembly of gurneys, which moves them into position for each phase of a particular operation. In the

case of myopia, for instance, a radial keratotomy procedure flattens the cornea so that images focus precisely on the retina.

As Dr. Fyodorov explains, superficial radial incisions are made on the cornea, composed of a connective tissue of protein called collagen. When the incisions heal, new collagen molecules replace those severed, which alters the cornea's elastic properties. The sliced cornea becomes more convex, while the untouched central cornea becomes flatter. Proper retinal focus is achieved.

The Fyodorov method separates the radial keratotomy procedure into five subprocedures, excluding pre- and post-operative treatment. The first surgeon, using individualized computer calculations—marks the in-

A high-tech sanctuary of stainless steel and high-quality optics, the operating theater of the Fyodorov Institute performs intensive eye microsurgery (above) using a radial assembly line. Doctors (below) perform subprocedures.





The Big Electron Beam [above] will be used to inject short-pulse electrons in the world's largest linear accelerator. Aside from high-energy particle experiments, Soviet researchers are studying industrial/medical uses of accelerator technology, including the 1.8-meter proton cancer therapy ring (below).

cision lines directly on the eyeball. The second doctor uses a diamond-sapphire scalpel specially machined to cut only to a precise depth. He makes radial slices on the periphery of the cornea. The third doctor—the team leader and the most experienced surgeon—makes deeper, more difficult cuts closer to the center of the cornea. The fourth surgeon checks the work of the preceding doctors, and the fifth doctor washes the eyeball and injects it with antibiotics. Patients walk away from the operating table.

Chief benefit, Soviet doctors say, is the quality control achieved when doctors work as a team, with the most experienced surgeon performing the most critical task. They claim the system has reduced post-operative complications by a factor of five.

But Dr. Eric Vilshansky, director of the eye institute's Moscow branch, explains that economics really sparked Dr. Fyodorov's surgical revolution. "The necessity for ophthalmological care is high, and only the conveyor technology and our computerized diagnostics can satisfy the needs of the population." He estimates that nearly 800,000 people in



the Soviet Union urgently need eye surgery. Fyodorov's system of intensive surgery will permit up to 250,000 eye operations a year when the institute's 12 satellite clinics are on line.

The eye institute's research and development center is already working on ways to merge laser surgery equipment with the conveyor system. And studies are under way to reduce post-operative rehabilitation time by stimulating cell regeneration. Options include laser or medicinal intervention, or boosting blood circulation in the eye using a field of electromagnetic energy.

Technology aside, Doctor Fyodorov has adopted a moving theme for his work on Moscow's outskirts: "We bring people back to life."

Secrets of Siberia

It is 4½ hours by Tupolev 154 trijet from the relative bustle of Moscow to Novosibirsk, or New Siberia. It's a transcendental journey that hurls you across the Urals, deep into the Asian wilderness to the River Ob. But in a way, it's also a journey to the past—to the very instant our universe began. Particle physicists at the world-renowned Institute of Nuclear Physics at the Novosibirsk

Science Center are using highly advanced colliding beams to probe the essence of matter, looking for particles that may have formed in the first picosecond of the Big Bang.

Two of the institute's electron-positron colliders are considered state of the art in the small but intellectually vigorous world of particle physics.

"The Soviets are absolutely world class in their area of accelerator technology," according to Harold Jackson of America's Argonne National Lab, which is collaborating with the Soviets by producing polarized gas targets for Novosibirsk accelerators. Indeed,

the researchers of Novosibirsk enjoy wide contact with their western colleagues in this inquisitive cult.

The quest—as it remains in the West—is to use large accelerators as precision observation tools to discern the tiniest particles of matter—quarks, mesons, muons, bosons and other subatomic particles that form the “zoo” raging within the heart of atomic nuclei. In so doing, they are peering into the forces of nature that bind the universe—the strong force, the electroweak force and the gravitational force.

Soviet physicists are planning to further their research by building the world's largest linear accelerator—called VLEPP—outside Moscow within the next two years. It's hoped that the system's superhigh energy levels—as much as 1000 billion electron volts—will produce even more elusive particles. Key to VLEPP will be a test damping ring called BEP, or Big Electron Beam, being built at Novosibirsk now. Scientists will use BEP to prepare short-pulse high-intensity electron beams—the kind that will eventually be injected into the VLEPP linear accelerator.

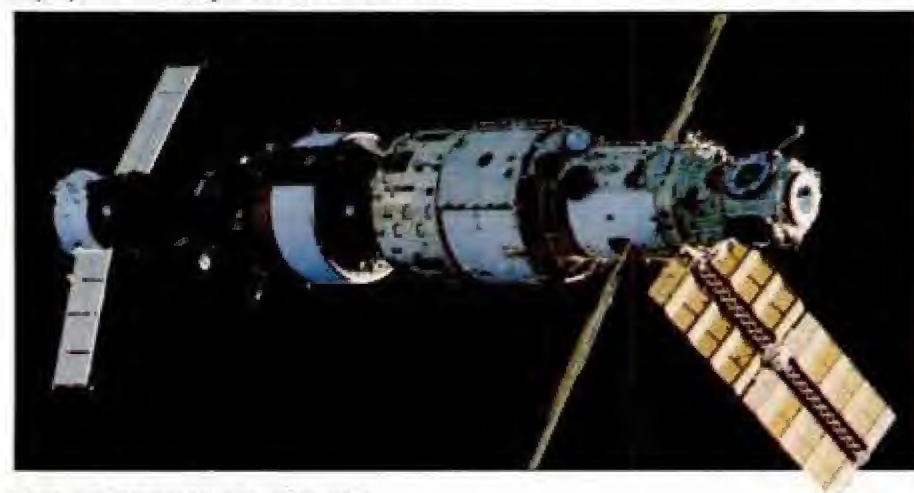
Other Novosibirsk accelerators have achieved world records for synchrotron radiation luminosity in their energy range, making them ideal for use as medium-energy light sources for future X-ray lithography applications—essential to the semiconductor industry.

Beyond advanced light sources and high-energy experimentation, the institute produces accelerators for industry. One intriguing offshoot: A proton cancer therapy accelerator that is small enough to be transported in several boxes by truck or aircraft.

The congenial Dr. Gregory Silvestrov, who helped establish the particle physics institute more than 30 years ago, is constructing the engineering test bed, which has a diameter of only 1.8 meters. Similar equipment in Japan and the U.S. is



The same type of Vostok booster (above) that hurled Yuri Gagarin into space is still used to launch small payloads. Proceeding from this humble beginning, the Mir orbiting platform (below) forms the basis of what will soon become a much larger station.



between 6 and 10 meters in diameter. The small ring consists of proton injection/ejection component, a radio-frequency beam focuser, a kicker magnet and an optical lens for beam correction after injection. The proton beam then bypasses the accelerator and travels to a patient in a nearby room or building, where highly focused proton beams eradicate tumors without involving adjacent organs.

Reach for the sky

After an hour's drive past Moscow's northern suburbs on a deteriorating 2-lane—past wooden *dachas* and immense satellite receiving dishes—one arrives at the heavily guarded Zvezdny Gorodok, or Star City, home of the Soviet Union's highly successful space program.

Access is limited, and Star City's campus-like surroundings engender a

RED TECH RISING

feeling of intensity and enterprise. This businesslike atmosphere does not preclude a touch of informality, however. We met Jean-Loup Chretien, the celebrated French cosmonaut, as he pedaled his bike to a training exercise.

Our guide for this inside look at Russia's space command turned out to be Cosmonaut Vladimir Lyakhov, a dedicated, confident pro, who, since a 1979 mission to the space station *Salut 6*, has spent a total of 235 days in orbit. Lyakhov was the focus of worldwide attention last fall when the *Soyuz TM* capsule he was piloting, with Afghani Cosmonaut Abdul Ahad Mohmand aboard, suffered a computer malfunction—forcing the pair to stay in space for an additional 25 hours. The mishap nearly entombed Lyakhov and crew in an endless orbit, according to Western observers. "Just a glitch with the computer software," was Lyakhov's Yeageresque response, exuding the kind of breezy nonchalance you'd expect from an ex-



Expanded capability: The new Soviet space shuttle *Buran* on the pad at Baikonur.

fighter test pilot. "We stayed up a little longer so we could land at our primary site in Kazakhstan."

Lyakhov's robust personality also went a long way to explain the success of Soviet space efforts—a physical toughness, a mental agility, a well-earned confidence. He evinced the kind of dedication exemplified by his cosmonaut colleague Dr. Valery Polyakov, who had his own bone marrow extracted in a painful operation to permit post-flight physiological comparisons.

Lyakhov pointed out a key element



The *Akula*-class attack submarine (top) and the *Oscar*-class guided missile sub (right) add offensive might to the Soviet navy.



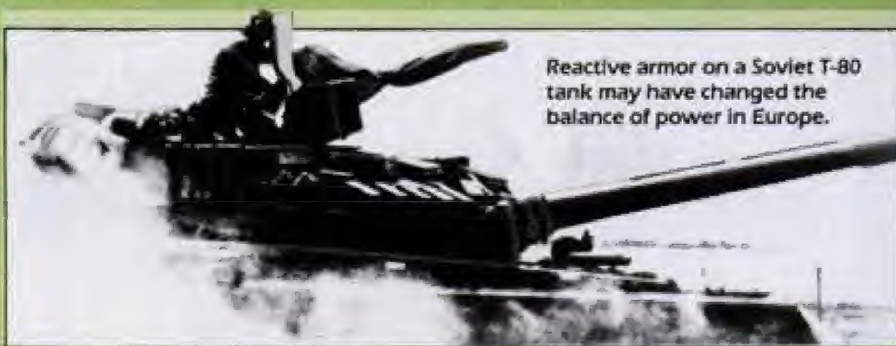
New Soviet War Machines

AS USUAL, news of any advancements in Soviet military hardware is met by considerable interest—and healthy respect—in the West. The year just concluded appears to have ushered in significant strides in Soviet military technology, according to U.S. Defense Department intelligence reports, with upgrades in power, accuracy and numbers across a wide spectrum of combat arms. In the right hands—unfettered by the Soviet's persistent penchant for overly restrictive command and control—these new weapons are considered potent factors in the changing tapestry of East-West relations.

On land: Advanced T-80 main battle tanks equipped with reactive armor are giving NATO planners serious concern. Reactive armor—actually a series of explosive boxes arrayed on the side of a conventionally armored vehicle—explodes outward against the inward force of an antitank munition, counteracting the round's destructive power. It's so effective that serious fears have been

raised that an entire generation of anti-tank missiles has been rendered obsolete. But teleguided smart munitions now being developed, like the 120mm antitank dart, are said to be able to penetrate this defensive component in the Soviet Union's vast tank arsenal. What's next? Intelligence sources indicate the Soviets are working on a turretless main battle tank for the future that will fire a pop-up gun from defilade positions.

In the air: Some Soviet fighters, like the MiG-29/Fulcrum, which made its Western debut at the Farnborough Air Show last September, are earning praise from Western observers. Boasting Mach 2 speeds and bone-crushing 9G maneuverability, the MiG-29 finished its daily air show routine with a crowd-pleasing tail slide. But in battle, the multirole MiG-29 can perform aerial combat, behind-the-lines air-to-surface interdiction or bomber interception using look-down, shoot-down radar. Its analog cockpit systems and hydraulic/pushrod control modes are a throwback, but the



Reactive armor on a Soviet T-80 tank may have changed the balance of power in Europe.



A Mainstay Aircraft Warning and Control radar aboard an IL-76 Candid transport.



The Soviet's swing-wing Blackjack bomber/penetrator bears a resemblance to the B-1B.



The world-class MIG-29 Fulcrum gives the Soviet's a new air superiority platform.



The Utki-class "wing in ground effect" craft can be used for rapid amphibious assault.

aircraft's AA-9 and AA-10 anti-aircraft missiles—in skilled hands—are said to meet Western standards. U.S. defense intelligence also suspects the Soviets are working on advanced air-superiority fighters and advanced air defense fighters for the next century. In addition, air defense coverage has been augmented by the Mainstay AWACS mounted on an IL-76 Candid transport, the first time the Soviets have shifted to Western-style aerial reconnaissance and control.

On the strategic side, outgoing Defense Secretary Frank Carlucci obtained a firsthand look at the Soviet Union's new strategic bomber last year during a visit to Kubinka Air Base outside Moscow. Although larger, the swing-wing Blackjack looks very similar to the U.S. B-1B. Defense officials say it has greater range and payload.

In the category of air transport, the Soviets recently introduced the AN-225, a stretched version of their mammoth An-124 Condor and now the largest plane in the world. An Utki-class "wing in ground effect" craft will soon be fielded to move men and machines on short, rapid deployments along the Soviet periphery, threatening Turkey, Japan, the Baltic and Scandinavia.

At sea: The Soviet's strong suit has always been home defense. But their ability to project power globally has been enhanced lately with continuing construction of full-size Kiev-class aircraft carriers.

The real strength of the Soviet navy remains with its submarine force, however, which has far greater numbers and more diverse types than any compara-

ble Western navy. Small, quiet diesel-electric boats are used for coastal patrol. A wide range of nuclear subs in attack, guided missile and ballistic missile roles add offensive punch. The Akula-class attack sub, for instance, is thought to be the world's deepest diver, its titanium hull capable of descending to nearly 3000 ft. An advanced fin-mounted sonar array is being used to find—and in the event of war—destroy American SSBNs, the most important leg in our triad of nuclear deterrence. New Oscar-class subs carry swarms of nuclear-tipped cruise missiles, and the huge Typhoon SSBN can be replenished far from home with surface ships like the Alexander Brykin, en-

hancing its ability to fight a protracted conflict.

Part of this offensive strength can be attributed to Western technology transfer. Toshiba milling machines that found their way to the Soviet Union have been used to fashion quieter submarine propellers. The B-1B and the Blackjack bombers bear striking similarities. The American Space Shuttle was clearly used as a template for the Soviet's *Buran*, a subtle but significant addition to the Soviet ability to wage war in space. It appears that an efficient espionage and fact-finding apparatus has accompanied these important new additions to Soviet military might.—T.H.C.



Cosmonaut Vladimir Lyakhov and PM's Tim Cole inside the Soyuz TM simulator.

in the Soviet space flight program: a disdain for gratuitous technological improvement at the expense of the tried-and-true.

"We learned how to travel into space almost 30 years ago," he explained as he showed me the controls of the improved, but still '60s-vintage Soyuz TM simulator. "So now we prefer to work on what we do when we get there, not how we go."

This emphasis on working in space—eschewing the exotic in favor of the proven, the durable—has yielded significant gains.

For instance: The Soviet space program has created a workable infrastructure of launchers, transports and orbiting stations that can support manned supervision of microgravity experiments. The Vostok booster that pioneer Yuri Gagarin flew into orbit in 1961 is still used for small unmanned payloads. The tested Proton booster lofts manned capsules, satel-

lites and interplanetary probes. The 3-man Soyuz TM capsule—based on older Soyuz designs—recently enjoyed upgrades in crew comfort, its recovery system and its infrared docking link. Progress—based on the Soyuz design—is the world's only unmanned cargo ship and space tug. The Soviet's Energya booster—successfully used to launch the space shuttle Buran last November—gives the Soviets a 200,000-pound heavy-lift capability today that the U.S. won't enjoy until the Shuttle C becomes operational.

This highly developed space system allowed the Soviets to launch 31 photo reconnaissance satellites in 1987. The U.S. didn't launch any.

Moreover, the Soviet manned presence in space has been virtually continuous since the Mir orbiting complex was launched in 1986. Although comparable in technology to America's '70s-era Spacelab, the ex-

pandable Mir can support a wide array of experimentation—growing industrial crystals and semiconductors, creating advanced polymers and medical compounds, observing Earth and the heavens, undertaking meaningful life science studies that will one day extend man's reach into the Cosmos. Chretien's Soviet/French mission last December—called Aratz—used an echo-Doppler biosensor to monitor human cardiovascular activity in microgravity, providing crucial information for long duration space flight.

Mir's follow-on modules—which will attach to the craft's 5-port docking hub in a spokelike pattern—will form dedicated test beds for Earth science or industrial experiments. The first module, a garage for the Soviet version of America's manned maneuvering unit, is scheduled to be launched this month.

Expanding on already significant capabilities, the Soviet space shuttle Buran—a close copy of our own Shuttle—was launched successfully last November. Lest we be complacent about the sophistication of at least some aspects of Soviet technology, Buran's scanning-beam microwave landing system, allowing completely automated unmanned flight, astounded Western analysts.

The Soviets are also well along in their efforts to explore the solar system. Venera spacecraft have made soft landings on Venus and probes have been dispatched to Halley's Comet. Last summer, Phobos 1 and Phobos 2 were launched from Baikonur Cosmodrome to rendezvous with the Martian moon that bears the same name. Human error appears to have rendered Phobos 1 inoperative. But the Soviets are confident Phobos

What's Hot In Moscow

SOVIET consumer products have always fallen on the debit side of the ledger in terms of number and variety. But Soviet planners have responded with Soviet versions—for better or worse—of common domestic items.

Not many companies can compete with Ford or Honda in matters of per-

sonal transport, but the Soviets are making a valiant stab at producing a serviceable commuter car with the Oka, a glorified Fiat. This diminutive 2-banger is named after the Oka river, which flows past the Volga Autoplant where 1000 copies of the car strained capacity last year. With a 649-cc powerplant developing 30 hp, the Oka will zip you in and out of increasingly hostile Moscow traffic for around 4000 rubles.

In the home electronics category: Availability of the Lithuanian-made Silelis S-445 television is reportedly greater, and although technical data is hard to come



Silelis color TV

by, PM's showroom test for picture quality and audio backup gave it a solid 5 on a scale of 1 to 10. The big trick will be to increase the number of state-controlled TV channels from the current three.

Not immune from an occasional touch of cleverness, the Soviet Walkman—called an Amphitone Active Accoustic



Oka 649-cc commuter car



2 will survive to carry out its mission of mapping the Martian plains, launching two sensors to *Phobos*'s surface and carrying out a unique soil sample analysis that involves bombarding the tiny moon with lasers. A manned mission to Mars is being planned for early next century, and critical life science experiments—like the unique “phytotron” that will be used to grow food en route—are well under way.

Closer to home, serious design studies are taking shape now that

Yuri Mikhailov and *Dolphin 1*, the Soviet laser-controlled fusion experiment. Inside the device's containment shell (below).



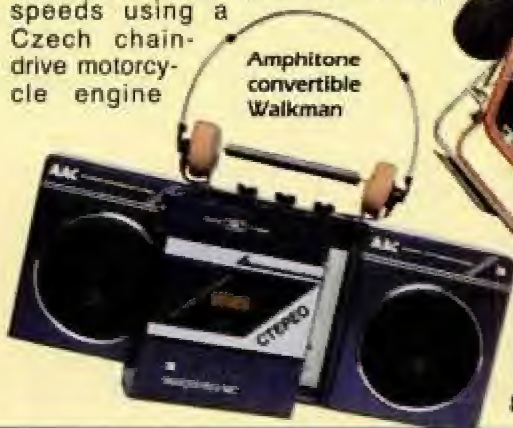
may one day result in orbiting power stations that will collect energy from the sun and beam it to receiving complexes here on Earth.

All of these space achievements didn't materialize without vast economic commitment and careful planning. In the end, the real success of the Soviet space program can be traced not to a triumph of technology, but to a triumph of will.

Powering tomorrow

Reliable thermonuclear fusion energy

System—has a detachable cassette drive and headset for voyagers on the Moscow Metro. For sport, Soviet citizens can turn to go-kart racing aboard the AKU-83 competition race buggy. This 85-kilo screamer boasts 80-kph speeds using a Czech chain-drive motorcycle engine



Amphitone convertible Walkman

AKU-83 go-kart

mounted adjacent to the operator (which, by the looks of things, will fry the right elbow off first-time drivers during high-G tail slides). Almost 8000 of these midget racers have

been produced to satisfy common speed lust—an apparently global affliction.

Huge hydroelectric dams and flying behemoths are the Soviet's strong suit, but they still have time to produce what appears to be a serviceable skateboard. Makers of the Aktay could improve deck and truck construction, however, with a little industrial espionage in Southern California.

Okay, consumer products are nothing to write home about. But maybe the Soviets can interest you in the world's largest punch press. . . —T.H.C.



Aktay skateboard

RED TECH RISING



The Soviets hope to achieve a closed ecological system with their future farm. Features include: 1. a computer center, 2. poultry house, 3. hog pens, 4. fodder plant, 5. manure recycling machinery, 6. heat pumps, 7. biogas converters, 8. fish storage, 9. smoke house, 10. silos, 11. vehicle storage, 12. 4-family home, 13. wind generator, 14. water pump and 15. photovoltaic cells.

has been an all-too elusive goal in Europe, Japan, the United States and the Soviet Union. Several tokamak fusion devices have been created, which use magnetic fields to confine the plasma that results when isotopes of hydrogen—deuterium and tritium—are heated. Despite the great promise magnetic confinement machines hold, however, most efforts to build a successful tokamak have met technical snags, and Soviet efforts have been no different.

But the Soviet Union still strives to capture the power of the stars at the Lebedev Physical Institute, where a new kind of device may one day create inertial confinement, or laser-controlled, fusion. Similar work is taking place in the States at the University of Rochester.

"Laser-controlled fusion machines can be smaller, simpler, less expensive," Lebedev's Yuri Mikhailov explained as we sat on top of the bracing



Soviet irradiation techniques have produced fast-growing wheat—circumventing the brutal Siberian winter.

for the target sphere, the Soviet Union's hope for limitless energy. "With a tokamak, you need a huge industrial complex and lots of precision. Here we just have our lasers, our optics and our containment shell."

As with tokamak technology, heating a laser device's deuterium-tritium target is critical to achieve the 100 million° C temperatures required to establish and sustain fusion. Electron cyclotron or ion cyclotron devices have been used for initial heating in tokamak experiments. But at Lebe-

dev, neodymium-doped glass lasers are being employed in this critical phase. The objective, Yuri explains, is to achieve high temperatures and ultrahigh, plasma-sustaining densities in the nanosecond "shot" when the Nd laser is split and recombined at the target focal point. The implosion that takes place on the surface of the target—confined within the spherical shell of stainless steel that Yuri patted like a faithful pet—is sufficient to spark a thermonuclear reaction, which, in future energy production, will heat a lithium moderator. The moderator will then transfer heat to a pressurized circulation system that will in turn activate a train of turbine power generators.

"The laser device has so many advantages over a tokamak," Yuri explained. "The system is relatively simple, so there are fewer problems. But the system also allows the kind of instantaneous plasma densities that fusion requires."

Yuri told me that experimentation will continue with *Dolphin 1*, his moniker for the Soviet laser-controlled fusion device. We talked while bulldozers and heavy trucks prepared a site just outside for *Dolphin 2*, the next-generation laser fusion machine and the one that may turn the trick.

At war with nature

Although it boasts a healthy, highly literate population, the Soviet Union can hardly be considered a land of plenty. Citizens vie for foodstuffs in sporadic supply—in a country where, not so curiously, 4 percent of the arable land in private hands produces 30 percent of the available meat, milk

(Please turn to page 154)

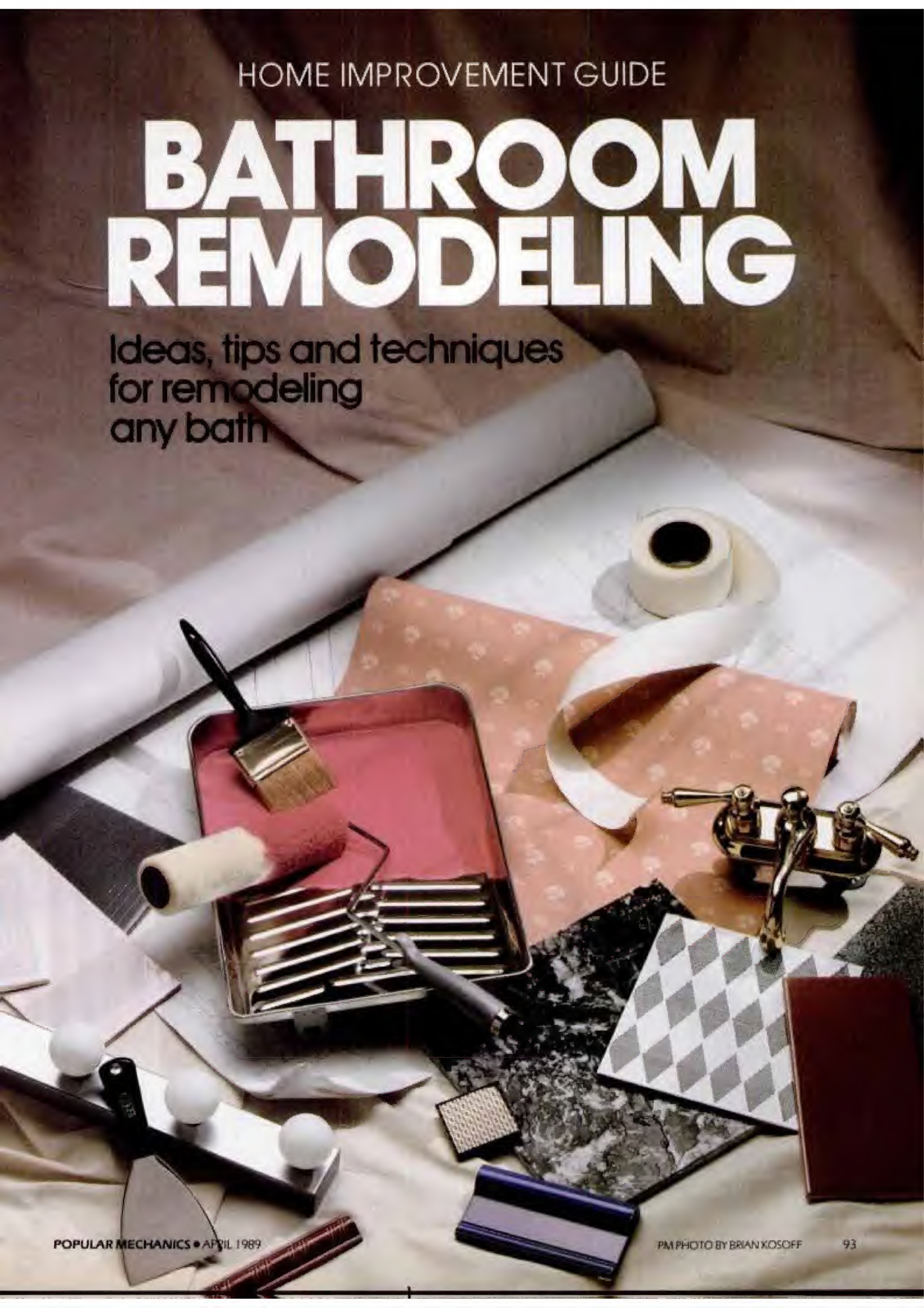


Speed meets splendor in the Moscow Metro.

HOME IMPROVEMENT GUIDE

BATHROOM REMODELING

Ideas, tips and techniques
for remodeling
any bath



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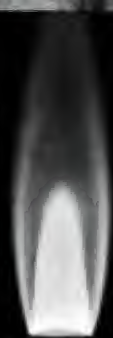
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MONEY.**



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It heats water
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The Bath

BY CLIFF GROMER; PM Photos by J.R. Rost



Old bath (above) had few amenities and dated decor. Major remodeling (right) included new fixtures and ceramic tile.

SOURCE LIST

- **Wall & Ceiling:** Del-Tile
—K-126 (country gray gloss)
- **Floor Covering:** Del-Tile
—K-1226 (country gray matte)
- **Laminate:** Wilsonart
—D-92-1 Solicore
(dove gray gloss and matte)
- **Toilet:** Kohler Co.—K-3385
Rochele (raspberry purée)
- **Sink:** Kohler Co.—K-2885
Man's Lav (raspberry purée)
- **Shower:** Kohler Co.
—K-1597 Cancun (tender gray)
- **Cabinet:** Nautilus Co.
—Kohler Color N-3236-RP
- **Lighting:** Nautilus Co.
—Kohler Color NSP-133-RP
- **Exhaust Fan:** Nautilus Co.
—N676
- **Window:** Andersen
Perma-Shield—CN-235T



FOR SEVERAL years, it's been the great room—a combination living room/dining room/den—that was the singular focal point in a house. A big space conducive to lounging around, partaking of food and drink and socializing. The bathroom, on the other hand, was a place to excuse yourself to. Visits there generally were brief

and to the point as the room itself was usually small, unattractive—or at least unappealing with white fixtures, white walls. Decor touches, if you call them that, were limited to perhaps an undersink cabinet and a fancy shower curtain.

But times are changing and so is the status of the once lowly bathroom. From a strictly functional trio of toi-

let, tub and sink, the bathroom is evolving into the glamour room of the '80s and '90s. Bathrooms are expanding into areas of spacious elegance and are often *the* feature rooms of today's homes. Some are even conversation pieces in their own right. Bathroom function is changing along with its look. Health, entertainment and relaxation activities are as much a part



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SURGEON GENERAL'S WARNING: Smoking Causes Lung Cancer, Heart Disease, Emphysema, And May Complicate Pregnancy.



WOOD BATH

- Wall & Ceiling Covering: Bruce Hardwood
- Flooring—E-80 Monterey Plank (toast)
- Skylight: Insula-Dome
- Floor Covering: American Olean Tile
- #615 Suedetone (toffee)
- Laminate: Wilsonart Plastic Laminate
- D-69-6 Solicore (clove)
- Window: Andersen Perma-Shield
- High Performance CN-235T
- Toilet: Kohler Co.
- K-3385 Rochelle (Mexican Sand)
- Sinks: Kohler Co.
- K-2187 Rondelle (Mexican Sand)
- Shower/Bath: Kohler Co.
- K-1406 Barbados (Mexican Sand)
- Cabinets & Lighting: Nautilus Co.
- Astor 14x24 N818BR; N45809
- Exhaust Fan: Nautilus Co.—N576

of the new bathroom concept as traditional uses.

Bathroom fever is now in high gear. Last year, homeowners spent close to \$5 billion in remodeling their bathrooms, a figure exceeded only very slightly by kitchen do-overs—a room that traditionally receives the heaviest helping of remodeling dollars.

Even new construction is focusing more heavily on bathrooms. They are being built larger and feature styling touches such as cathedral ceilings, ex-



New bath (top) has lighter, airy feel than old room (above). New fixtures, vanity, window, skylight and panelling create feeling.

pansive windows, multilevels and provisions for the latest fixtures for hygiene and recreation. Either way, making the investment in remodeling an existing bath or stretching the budget for a superbath is money wisely spent. It is one of the few investments you can make in a home that pays you back when (and if) you sell your home.

One of the big trends in a bathroom design is just that—bigness. Bathrooms that sprawl 200 to 300 sq. ft. ri-

val the size of a living room a decade ago. There's enough room here to create an indoor resort, and some folks are doing just that to the tune of tens of thousands of dollars. Remember, we're talking about one room here.

Contemporary bathrooms go far beyond sheer size, including his and her sinks and toilets and heated toilet seats. The old WC (water closet) is rapidly transforming itself into a bathing suite. Luxury items like whirlpool baths and big hot tubs no longer are exclusive toys of the rich.

The bidet is one fixture that is once again becoming socially acceptable. But still they are nowhere near as popular as showers-for-two with dual shower heads and a choice of water or steam for your own private sauna. The ultimate in bathroom extravagance is the environmental spa where you can call up a totally controlled environment—sunshine, rain, steam or wind. Equipment such as exercise bikes, and accommodations such as dressing rooms and the like also enhance the indoor spa ambience.

You can't hide this kind of luxury. You want it to be seen and appreciated. Socializing in the spa-like atmosphere of a hot tub is a lot more fun and more relaxing than sitting around, talking in the living room conversation pit.

Of course, one problem is that most homeowners don't have a spare 200 or 300 sq. ft. sitting around waiting to be converted into a bath suite. And unless you're talking about new construction or an actual addition to your present home, most of you will have to forgo the luxury of a really spacious bath. But don't despair. You can still tap into today's trends in baths using the fashion, rather than the space approach.

Choice of color

A few years back, you had to go to an interior decorator to get that high-fashion custom look. Today it's a lot easier. You can do it yourself. Color coordination is a big trend in today's bathrooms. According to June Roche, color consultant to such companies as General Motors, Burlington Industries and American Standard, color is the most important bathroom decorating trend today. And color is a constantly changing factor. Right now we're shifting away from the darker masculine colors that used a lot of grays to lighter, cleaner more feminine hues. The exception is bold black, white and reds which seem to have their own hardcore following.

Another new concept, according to

Roche, is the tone-on-tone look. This is the blending of shades in the same color family for the bath suite. For example, you might have a light blue pedestal sink and a bathtub in a deeper shade of blue. "The coming trend," says Roche, "is the movement toward brighter colors with more chrome. Colors that are pretty, more feminine, bright tones, as opposed to heavy, bold tones."

Some manufacturers have made it incredibly easy to tap into today's decorating trends and color fashion. Kohler Co. has come up with its Kohler Color Coordinates program in conjunction with other manufacturers such as Pittsburgh Paints, Dal-Tile ceramic tile, Wilsonart laminates, and Braun-Nautilus bathroom cabinets and lighting fixtures to produce a whole range of products that you can use to color coordinate or contrast in your bathroom remodeling plans. American Standard and American Olean Tile have a similar, but less expensive, program.

Available colors themselves have broadened dramatically in range from whispering quiet pastels and beiges to bold and brassy reds and blacks. So you can branch out in any direction to glamorize and sensationalize your bathroom with only your imagination and wallet size being the limiting factors.

Bath fashion doesn't end with color, however. Browse through fixture manufacturer catalogs and you'll quickly see that bathroom fashion and style caters to just about any taste. You can easily create a period look with fixtures and trim items that look like they're out of the roaring '20s or straight out of 2001.

You can even create your own custom look. One way is by using conventional materials in a unique or unusual way to come up with something really eye-catching. Installing wood flooring or metal laminate on walls and ceilings are just two examples.

The rest of this section will give you some ideas and techniques for incorporating some of this glamour into your existing bathroom. We've created feature look rooms by using some of the latest decor fixtures and also by the creative and unusual use of some common materials. We'll also show you what's involved in handling the plumbing, electrical and carpentry jobs that you're likely to encounter in the remodeling routine. So read on and begin planning your glamorous new bath suite now. Just don't forget to check your local building codes before undertaking any work. **PM**



Hi-tech bath (top) was made possible by gutting room [above] and adding new fixtures, flooring and metal laminate to walls.

CHROME BATH

- **Wall & Ceiling Covering:**
Wilsonart Laminates
—Decorative Metals;
419/6251 Polished Natural Aluminum;
419/6295 Polished Black Aluminum
(Strips)
- **Floor Covering:** American Olean Tile
—W10 Cumulus (8 x 8);
W21 Onyx (8 x 8)
- **Plastic Laminate:** Wilsonart
—1595-1
(gloss black)
- **Toilet:** Kohler Co.
—K-3385
Roche (black black)
- **Sink:** Kohler Co.
—K-2120
LeGran Lav

FOR MORE INFORMATION

- **American Olean Tile**—American Olean Tile Co., Lansdale, PA 19446-0271
- **Andersen Windows**—Andersen Corp., Bayport, MN 55003
- **Bruce Hardwood Flooring**—Bruce Hardwood Floors, 16803 Dallas Pkwy., Dallas, TX 75248
- **Dal-Tile Ceramic Tile**—Dal-Tile Factory, 7834 C.F. Hawn Freeway, Dallas, TX 75217
- **Insula-Dome Skylights**—Insula-Dome Skylights, 83 Horseblock Rd., Yaphank, NY 11980
- **Kohler Plumbing Fixtures**—Kohler Co., Kohler, WI 53044
- **Nautilus Bath Accessories**—Nautilus Co., P.O. Box 159, Hartford, WI 53027
- **Wilsonart Laminates**—Ralph Wilson

- Plastics Co., 600 General Bruce Dr., Temple, TX 76501
- **General Contracting**
■ **Ron Riker Inc.**—32 Evergreen St., Keyport, NJ 07735
- **Plumbing Contracting**
■ **Vincent Siciliano**—Siciliano Plumbing & Heating, P.O. Box 651, Matawan, NJ 07747
- **Tile Contracting**
■ **Rich Burnup**—4 Citation Ct., Tinton Falls, NJ 07724
- **Laminate Construction**
■ **Flo Dar Inc.**—Highway 35, Cliffwood Beach, NJ 07735
- **Electrical Contracting**
■ **C.P.B. Electric**—48 Hedgewood Rd., Howell, NJ 07731

Demolition, The Right Way

DEMOLITION involves removing structure by working in from the finished wall to the joists and studs, if need be. But the process is not simply

running amok with a sledge hammer and wrecking bar. There's a right way and wrong way to proceed.

As you get into the walls, there's a good chance you'll expose compo-

nents of your house's vital systems—plumbing, electrical, heating ductwork and possibly gas lines. You'll be generating a lot of debris, so make plans on how to get rid of it without tracking it all over the house. Dust control is equally important. As a rule of thumb, 1 sq. ft. of wall demolishes into about 1 cu. ft. of debris.

Other hazards to prepare for include exposed nails, wall and tile fragments, wood splinters and assorted sharp scraps. Protective gear—safety goggles, dust mask, work gloves and work shoes (not sneakers)—are wise precautions, perhaps even a hard hat. Remember to remove any mirrors and pictures that are on the *other* side of the wall. Vibrations can knock them down.

By the numbers

Follow this removal sequence: decorative trim, contents of cabinets, fixtures and appliances, countertops, cabinets and shelves, flooring, light fixtures, wall coverings, plumbing, electrical and heating elements and structural wall members.

Turn off the water at the main shut-off and cut off the electric circuits going to the bathroom at the fuse box or breaker panel. This is a good precaution against leaks and electrical shorts in case you accidentally hit pipes or wires when working in the walls.



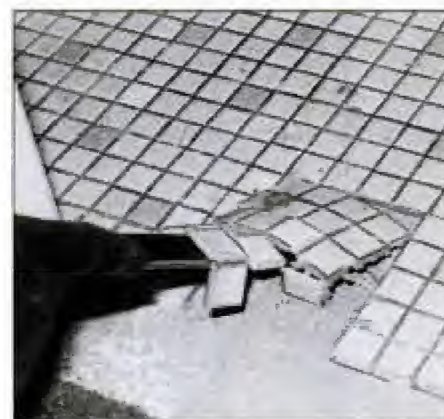
There is more to demolition than simply tearing out everything in the room. A good strategy is required to keep the mess to a minimum and prevent personal injury.



1 First remove all of the casing material from the window and the door jambs. Use a flat bar or crowbar for this job.



2 Carefully remove any mirrors in the room, then pry out the medicine cabinet. Be sure to remove screws that hold cabinet first.



3 Use a flat bar to lift off floor tile or vinyl flooring. Be sure to wear eye protection to prevent injury from the tile chips.

Set up your exit for the debris. Throwing it out a window onto a safe landing area is preferred to carrying it out through your house. The best method is to construct a chute of 2x4s and plywood to slide debris into a dumpster. Don't expect to completely contain dust to your work area. But you can minimize its travel by closing the door and laying a damp towel along the bottom. If the door has been removed, tape a heavy dropcloth over the doorway. Stuff rags into any heating or air conditioning registers in the floor to prevent clogging. Do the same with open waste pipes.

Down to work

Now you're ready to attack. Remove wood trim by prying it away from the walls with a flat bar. Door frames are removed the same way, and jambs can be cut and removed in sections. To remove drywall, locate an area between two studs (tap on the wall and listen for an area with the lowest pitch) and knock a starting hole in the drywall with a hammer.

If ceramic tile is glued on the wall, strip it off first using a prybar to get underneath the tiles. Don't smash the tiles themselves with a hammer or you'll get knife edge fragments flying around. Remove sections of drywall nailed to the studs by prying them off with a claw hammer or flat bar.

Corners of drywall use a rigid metal bead that has very sharp edges so don't try and remove this with your hand. You can remove this in sections by cutting it with a hacksaw and pulling it out with a hammer claw, pliers or prybar. Lath and plaster walls require more patience as there is potential for a lot more dust. Hand tools will generate much less dust than power tools. Work on the wall one section at a time. Gently break the plaster away from the wood lath with a claw hammer, wrecking bar or masonry chisel. Pull away the lath with a prybar. If

you're removing a small section of wall, mark off the area with masking tape and knock down the plaster. Cut out sections of lath with a handsaw. Try to cut as close to studs or joists as possible to minimize plaster-cracking vibrations.

Wood paneling is removed by first pulling off the baseboard trim to gain working access. Then, use a flat bar to pry the panels away from the studs. To pick up hardwood flooring, also remove the baseboard and work up the sections of the flooring with a prybar. You may have to cut the first board with a circular saw. Opening exterior walls provides an opportunity to evaluate the insulation. In our project, we upgraded the original rock wool insulation with fiberglass batts.

Before removing electrical outlets and switches, use a voltage tester to make sure the circuit is disconnected. Remove the wires connecting the unit and remove the outlet or switch. If the unit is located at the end of a run, trace the wires back to the nearest junction box and remove them. If the unit is in a line run, reroute the wire by backtracking to the nearest junction box and adding a longer, unspliced wire.

Galvanized plumbing pipes can be disassembled with two wrenches or cut with a hacksaw. Hubless cast-iron pipe can be disassembled by removing the clamps, or it can be cut with a special chain cutter or power circular saw fitted with a special toothless blade. Copper pipe can be disassembled with two wrenches if connected with flare fittings. Sweated fittings can be removed by melting the solder with a propane torch. The pipe also can be cut with a tubing cutter. Plastic pipe is cut with a hacksaw. Remaining sections of pipe can be capped off or extended for new fixtures. Sheetmetal ductwork can be cut with tin snips or can be disassembled by unscrewing the sheetmetal screws. **PM**



4 Remove tile from around tub using a flat bar. If you plan to keep the tub, be sure to protect it with cardboard or a blanket.



5 Remove drywall or plaster with a straight claw hammer or flat bar. Wear a high-quality dust mask and eye protection at all times.



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Skylight Installation

SKYLIGHTS can really open up a bathroom. They provide much more illumination than do wall windows. And natural, rather than artificial, light helps create an airy ambience, making the room appear larger than it really is. Add to this the benefits of fresh air from models with operable sashes,

and it's easy to see why skylights are so popular.

Skylights come in a variety of sizes and are usually made to fit into standard rafter openings. A small unit, 14½ in. wide will fit between rafters that are 16 in. on center. Larger sizes require cutting out one or more rafters. For our project, we selected a venting

model made by Insula-Dome. This unit features low-E glass which cuts down on heat loss in winter and heat gain in summer, a full-support hinge and 16-oz. copper flashing.

Positioning

Begin the installation by determining where you want the skylight located. The skylight size indicates the outside curb or rough roof-opening dimensions. The width dimension is parallel with the roof ridge. To get your correct rough opening add ½ to ¾ in. to the skylight size. Try to make these dimensions work to the best advantage with your rafter spacing.

If you have a dropped bathroom ceiling or an attic space, check above the ceiling for any interfering electrical wires or ductwork to see if they can be rerouted. These may be hidden under the ceiling insulation so you'll have to pick up the insulation to check. Have someone tap on the ceiling with a screwdriver or broom handle to keep you in the desired area. Keep in mind that if you're installing a skylight that opens, it should be at least 10 ft. away from any plumbing vent pipes to prevent fumes from entering the window.

Layout

Once you establish your skylight location, use a framing square and mark off the rough opening area on the ceil-



Installing a skylight is always a great way to bring more natural light into a room. But it is especially appropriate for bathrooms which tend to be small and relatively dark.



1 Decide where to position the skylight in the ceiling, then bore a hole through the roof at all four corners of your layout.



2 Snap chalklines between all four layout holes, then cut and remove shingles. Cut sheathing with a reciprocating saw.



3 Carefully pry sheathing off rafters, remove nails to avoid injury, then discard. Do not let scrap fall into room below.

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ing. Then, cut away ceiling material and transfer your measurements to the outside of the roof by boring a hole at each corner of your layout through the roof, using a large drill bit. Moving to the outside of the roof, recheck your dimensions in case you drilled the holes on a slight angle.

Connect the drilled holes by snapping chalk lines. Then, cut the asphalt shingles inside the perimeter with a utility knife and remove the shingles

with a flat bar. Also remove the roof felt from the rough opening area. Follow the manufacturer's recommendations for stripping shingles beyond the rough opening. Do not strip the shingles past the bottom of the rough opening.

Once the sheathing is completely exposed, snap new lines if necessary and cut the sheathing with a reciprocating saw. The reciprocating saw will cut through hidden nails that can

damage circular saw blades. Pry up the cut sheathing from the rafters.

Rough opening

To frame out the rough opening, begin by cutting the rafters $1\frac{1}{2}$ in. past the rough opening on both the top and bottom. The manufacturer's specific installation directions will tell you whether these cuts should be made plumb or perpendicular to the top edge of the rafters. Your choice will depend on the way you want to install the finished trim around the window and how you want the window to look in the room.

Headers are normally installed at the top and bottom of the skylight. You may want to double up on your header size for strength. In this case, allow for the extra header thickness when cutting back your rafters. You can also double up on your side rafters. Nail the headers directly into the cut ends of the rafters with 10d or 12d common nails and toenail them into adjacent rafters that haven't been cut. Make sure they are perfectly square. Nail the edges of the cut roof sheathing into the tops of the headers.



4 Cut rafters that fall in opening, then cut and nail header stock in place. Header transfers weight to the adjacent rafters.



5 Slide skylight frame into place, then flash according to manufacturer's directions. When done, install the window panel.

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Installation

You can ease the burden of carrying a large, heavy skylight up a ladder by removing the glass. We were able to hand up the frame diagonally through the rough opening from the inside. Center the skylight over the rough opening by measuring the clearance inside using a ruler. Also from the inside, nail the unit to the rafters through the liner box, not through the copper flashing. You can also run a bead of roofing cement on top of the flange for extra leak protection. Replace any extra shingles and install flashing according to the manufacturer's directions.

Flashing

Although proper flashing techniques will vary widely depending on the individual manufacturer, there are some general principles that hold true for all skylights. To begin with, whenever you cut a hole in your roof, you drastically increase the chances of leaks. No matter how carefully you install the unit, even the slightest mis-cue can spoil your ceiling during the first heavy rain.

Most skylights will require some form of step flashing. Unless you had your skylight custom designed and built, this flashing is included in your

purchase price. Generally speaking, this flashing is comprised of a series of identical L-shaped aluminum pieces that must be installed around the perimeter of the skylight frame. One leg of the L abuts the frame, while the other is installed below the roofing.

To install step flashing properly usually requires that the roof shingles that abut the window frame be removed at least 6 to 12 in. away from the window curb. A flat bar works great for this job. Just slide it under the first shingle at the top of the skylight and pry up. You should be able to remove the roofing nails by lifting the shingle that covers them and pulling out the nail. If you work carefully, the shingles you remove can be used again.

By working downward you will clearly expose the nails that must be removed in the ensuing courses. Usually it's a good idea to remove the shingles in whole pieces, that is, back to the next joint where a new shingle begins. Once a clear path has been removed on both sides, check the manufacturer's directions to discover how many shingles must be removed from above the window to accommodate the proper top flashing.

Then, just reinstall the shingles, alternating them with the individual

pieces of step flashing as you go. Be sure to use liberal amounts of plastic roof cement during the installation, to make sure that shingles and flashing are bound together and that each course of shingles is glued to the next.

Light shaft

When you are dealing with a ceiling other than a cathedral, you will have a space between the skylight unit and the ceiling below. The size and shape of this light well or shaft depends on various factors—the construction of the roof and ceiling, the desired amount of light to enter the room, and the appearance of the entire area. On this job we created a cathedral ceiling by removing the ceiling joists. This made the room airier, and also solved the problem of constructing a light shaft below the skylight.

If you want a light shaft, simply frame out the area between the roof rafters and the ceiling joists with appropriate lumber. Keep in mind that this shaft can be designed to extend straight down into the room or be aligned perpendicular to the roof opening so it comes into the room at an angle. Box in the shaft with plywood, drywall or paneling. Finishing off with white paint will better help reflect exterior light into the room. **FM**

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New Windows



Whenever you undertake a major remodeling job in any given room, you should consider replacing old windows. New high efficiency models will save energy and work better, too.

AN IDEAL time to replace windows is when you're remodeling rooms in an older house. Choosing new, more efficient windows will also enhance the updated look you are going for. More glass area will allow more light into the room. And this can add to the room's ambience by creating a feeling of greater spaciousness.

To remove an existing window, check our article on installing oversized plumbing fixtures that follows in this guide. Your choice of a new window is limited only by your budget and the dimensions of your bathroom wall. (You should also consider how your new windows will look from the outside of your house.) There are so many different window styles available these days, be sure to undertake careful comparison shopping before making any purchase.

The simple switch

Regardless of the window you choose, the best way to approach the replacement job is to buy a window that's the same size—or slightly smaller than—the window you are removing. If this strategy fits your needs, the whole task is much more straightforward. On this job, we replaced two different windows. The first was just slightly smaller, so we could use the existing wall framing for our new rough opening. All that was required was adding 1x4 stock to the side of both jack studs and to the top of the rough sill.

Oversized replacements

Our second window, however, was wider than the window it was replacing and so a new rough opening had to be constructed to accommodate it. If the desired rough opening falls in a



1 After you remove old window, you may have to adjust the size of rough opening. Just nail boards to the sill and/or studs.



2 Push new window into place and have helper hold it from outside. From inside, adjust it until centered in rough opening.

bearing wall, you must first build a temporary support wall to carry the weight of the ceiling above, while working on the wall. Make this bracing wall using a few studs nailed between a single top and bottom plate. Make the wall high enough so it just fits between the floor and ceiling. Slide it in place, within a couple of feet of the outside house wall, being careful not to harm the ceiling or flooring if these items are not going to be replaced. Then remove the jack studs, header, cripple studs and sill plate from the old opening.

Lay out the position of your new rough opening on the top and bottom wall plates, and then cut to the proper size studs, jack studs, cripple studs, sill plate and header for your new opening.

(The installation instructions that come with the window will explain the

exact size for your new opening.)

Assemble these parts by first nailing the jack studs to the header. Then lift this assembly into place and toenail the bottom and top of the studs into the bottom and top wall plates. Then toenail your sill in place at the proper height and fill in below it with cripple studs that fall in the same 16-in.-on-center layout that the rest of the studs in the wall maintain. Add short filler blocks above the header to support the top plate.

Installation

Once all these members are in place, you can remove your temporary support wall and disassemble it. Then, slide your new window into place. Have a helper hold the window on the outside while you center it in the opening using a flatbar to move it from side to side. If the window is a double-sash casement model, like ours, then be sure to shim between the mullion and the sill to keep the window from sagging in the middle.

To make sure you don't push the shims in too far—and thus raise the middle of the window too high—sight along the bottom edge of the window to make sure it's straight.

When satisfied with the window alignment, nail it in place by driving



3 Slide shims under center of wide windows to keep middle from sagging. Use tapered cedar shims to allow for precise adjustments.



4 Once window is properly aligned, hold in place and nail from outside, through brick molding or a built-in nailing flange.

casing nails through the outside brick molding and sheathing into the jack studs. Or, nail through the casing flange—if the window is built with one—into the sheathing using 2½-in. roofing nails.

Finishing up

Once the window is installed, cut and piece in the siding around the exterior trim and caulk all the spaces between the siding and the window trim.

When the time comes to install your drywall, plaster or paneling inside the house, make sure to add insulation between all the new framing members. Also, add insulation between the window and the rough opening to prevent heat loss and drafts—before you cover this cavity. Don't pack the insulation too tight. Then finish the job by installing new casing material around the window.

PM

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Unwanted Plumbing

IF YOUR remodeling project involves removing fixtures that will not be replaced, you have to do something with the plumbing (supply and waste pipes) that remain exposed. In one bathroom we remod-

eled, we eliminated a tub and shower unit to make the overall room larger.

First step with any fixture removal is to shut off the main water supply and eliminate the pressure by opening the sink or tub faucets.

Removing toilets

Shut off the water supply going to the tank and flush once or twice to drain the tank and bowl. Use a sponge to remove any water remaining in either area. Disconnect the supply line at the shutoff valve and the tank. If the tank is attached to the bowl, you can unfasten the bolts and remove the tank to make the toilet much lighter. If you have some help, leave the parts joined together and remove it as one piece. Unbolt and remove the toilet seat. The bowl is fastened to the floor flange with two bolts. If the bolts have plastic caps, pry them off with a screwdriver. The nuts usually become rusted because of the humidity in bathrooms. If you can't remove them with a wrench, cut them with a hacksaw.

Rock the bowl to break the wax seal. Then, lift the bowl straight up by the rim and the back. There still will be water in the trap. Dump this out by placing the bowl on a towel in the tub and tipping it over to drain the trap. Stuff the waste pipe with a large rag and cover it to keep out debris and prevent sewer fumes from entering the house.

Removing washbasins

Washbasins (sinks) may be free-standing units, wall hung or mounted into a countertop in a vanity. Your approach depends on your situation. But the first step for all is the same: Close the shutoff valves and disconnect the supply lines at the valves. Place a bucket under the trap and disconnect



If you want to remove—or relocate—a plumbing fixture, the job requires more than just taking the old fixture out. You must also cap off the old plumbing behind the surface of the wall.



1 First remove all faucets, escutcheons and other fittings, like a tub spout, that are accessible from the outside of the fixture.



2 Remove the fixture and the wall covering behind it, then cut the rough plumbing with a tubing cutter. Don't use a hacksaw.



3 Once old supply lines are cut, pry them from the wall and set aside. Frequently, they can be reused, so don't throw them away.

HOME IMPROVEMENT GUIDE

the trap by unscrewing the locking nuts at either end. Leave the straight drain pipe connected to the sink in place. If the washbasin is free-standing, you should be able to just slide it away from the wall after the plumbing is disconnected. If the washbasin is wall hung, remove the legs—if the sink has them—and lift the basin straight up from the bracket. The support bracket is mounted to the wall, but the sink just rests on it. The plumbing attachments and the

sink's weight keep it from moving.

To remove countertop-mounted basins, place a piece of 2x4 that's several inches longer than the width of the basin on top of the basin. Tie a piece of clothesline or wire to the wood, drop it down the drain, and connect it to a short section of 2x4. Twist the bottom block to take up any slack, then remove the bolts and clips securing the basin to the counter. Hold the basin at the bottom and loosen the support line until the basin is free and able to be re-

moved through the countertop hole.

You can also remove the basin along with the countertop in some cases. If the countertop is simply screwed to corner blocks in the vanity cabinet, remove these screws and the top should lift right off—with the sink coming along in the bargain. The vanity is attached to the wall with screws driven into the studs. Removing these will free the cabinet.

Eliminating pipes

Depending on whether your supply and waste pipes come out of the wall or floor, you will have to go into the wall or tear up the floor and remove the pipe back far enough so it can be capped off and hidden during the reconstruction.

Galvanized pipe uses threaded connections for fittings and joinings. Copper pipe fittings are usually soldered but are sometimes threaded by means of flared compression fittings. Remove supply line shutoff valves (these may require heat to loosen) and take your supply and waste pipes back to a convenient disconnecting joint or soldered coupling. If a threaded coupling is rusted fast, heat it with a torch and tap it with a hammer to



4 Thoroughly clean the cut ends of the tubing that will remain in wall. You can use either emery paper or fine steel wool pads.



5 Apply flux to end of tubing, then slide cap fitting on tight. Heat the joint with a torch until solder melts and fills gaps.



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free it. You can cut copper lines with a tubing cutter.

Next, cap off your supply lines. If they are galvanized, you need a galvanized cap. Clean the pipe threads and apply pipe dope or Teflon tape and turn down the cap with a pipe wrench. With copper pipe, sweat on the cap.

In some locales, plastic supply lines are permitted. These are the easiest to cap off. All that's required is cutting the pipe with a hacksaw and gluing a cap over the cut end. Be sure to use the manufacturer's cleaning solvent before the glue to ensure the best joint possible.

Removing shower stalls

Remove your shower doors. On hinged doors, unscrew the hinges from the wall, remove the door and take apart the rest of the frame. If you have sliding doors, lift the doors off the tracks. You first may have to raise the upper bar of the frame.

Unscrew or pry apart the rest of the frame. Unscrew all the handles, controls and the showerhead. Then strip away fiberglass or plastic surrounds with a prybar.

If your shower is covered with ceramic tile, the job is a bit more involved. You'll have to pry the tiles off the walls individually, using a flat bar.

This will take some time and can create razor-sharp shards of tile. Because of this, be sure to wear sturdy gloves and eye protection at all times. Once all the tile is removed, strip off the mortar, plaster or drywall behind it, until you reach the studs. This wall covering will be so damaged that you'll have to replace it.

Removing a bathtub

If you have glass shower doors installed, remove these first. If your tub is set into the wall rather than free-standing, it usually is attached to the wall studs with nails or screws driven through a flange. Strip away the wall covering to access the flange and free it from the studs.

If the tub plumbing is not accessible, cut an access panel in the wall closest to it, by cutting out a section between the two studs closest to the drain. Use a knife rather than a saw to minimize the danger of cutting wires or pipes in the wall. It's a good precaution to turn off the electricity going to the bathroom. Cut your panel about 14 in. high starting about 2 in. from the floor. Cut the wall along the center of your wall studs.

Relieve supply line pressure by opening the faucets. Remove the tub overflow plate and take out the entire

assembly. Remove the faucets and unscrew the spout.

Disconnect the drain by removing the drain strainer with a screwdriver and inserting the handles from a pair of pliers into the drain crosspiece. Use a screwdriver as a lever to turn the pliers counterclockwise until the crosspiece turns freely. Pry up one end of the tub at a time and slide a 3- to 4-ft. section of 1x4 underneath each end. Pull the tub away from the wall by sliding it on the wood.

If the tub is an old cast-iron model, one of your biggest problems will be getting it out of the room. These fixtures are *extremely* heavy. Some professionals will actually break up the tub in the room by striking it with a sledgehammer. There are obvious dangers to this approach. A better idea is to remove it in one piece and then carefully navigate through the house and then outside.

If you have wood or tile floors, an old section of carpeting is great for this job. Just wrap it around the tub and carefully slide the tub using the carpet as a buffer. If you have carpeted floors, then use heavy gauge cardboard for the buffer. In either case, take your time and have plenty of folks to help, especially if you're sliding the tub down stairs. **PM**



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Working With Oversized Fixtures

THERE'S a wide selection of standard fixtures designed for bathroom remodeling, but there are additional fixtures available for new construction. These tend to be built on a grander scale, are more luxurious, and have more built-in amenities. A shower unit in this category, for example, may have features such as 1-piece construction and molded-in seat and shelves. The reason these units are designed for new construction is that they can be installed before all the partitions are up. If you're remodeling, you usually have to settle for fixtures that will fit through your bathroom door. Anything larger is considered oversized.

You can install oversized fixtures

by opening up an access in an exterior wall. This usually involves removing a window and the framing below it. If you don't have a window, you'll have to cut a whole in the wall which requires temporary support for the ceiling or roof above.

For our project we installed an oversized shower and tub enclosure in a ground floor bathroom and an oversized shower enclosure in a second floor bathroom.

Getting started

To remove the window, begin by taking off the interior casing. Moving to the exterior, pry the window from the rough opening. With the window free, lift it out bottom first and let it slide

down into the opening as you pull it out. If you remove the window from the top, there's a danger it can topple and fall on you. Back inside, remove the wall covering under the window frame. In our case this was drywall. Remove the sill and also the cripples, which are the small studs that hold it up. Do not remove the bottom plate.

For our upstairs bathroom, the shower enclosure was carried up two ladders, rather than sliding it up a ladder, to protect the fiberglass. The protective framing is kept in place until the unit is installed. Once the unit is through the opening, reinstall the sill, cripples, sheathing and siding.

Before installing the fixture, relocate the waste pipe if necessary (see



Oversized tub and shower enclosures, like this fiberglass unit, are roomy and luxurious. But they're too big to move through your house. Here's the way to make them work.



1 Begin by removing the interior casing from your window using a flat bar. Be careful of this trimwork if you plan to reuse it later.



2 Remove nails that hold window in place from outside. Be careful not to split brick molding. Then pry out window unit.

"Relocating A Toilet," page 114). In our case, the plumbing supply lines were moved over with flexible, coiled tubing rather than straight pipe to make the job easier. When setting the tub, make sure the drain is lined up with the waste pipe so you can install the drain assembly.

Gently tap shims underneath the tub to level the unit. Fasten the top flange of the unit to the wall studs with roofing nails. If the flange is not prebored for these nails, bore clearance holes to avoid cracking the fiberglass. Protect the bottom of the tub

with some old carpet or cardboard since you'll be standing in it to work.

Install the drain, sealing it with plumber's putty. The overflow riser fits into the port opening with a gasket. Use plumber's putty here, too. We waited to frame out our partition wall at the end of the enclosure, until after the plumbing was completed because we were working in an extremely tight area.

Line up your water supply and install the diverter valve. The diverter comes assembled and the manufacturer supplies working dimensions

for the installation. Lay out these dimensions on the enclosure and drill through the fiberglass into a block of wood with a spade bit to avoid chipping. Connect the hot and cold supply lines to the diverter and secure it to the fiberglass by adding the faucet handles on the inside surface. The diverter riser for the shower head was positioned about 6 in. above the shower enclosure. The riser pipe is supported by a block nailed to two studs in the end wall framing. Once the tub is set, frame out a 2x4 wall behind the diverter and around the plumbing. **PM**



3 Carefully remove the siding from below the window, starting at the window opening and working down to the bottom plate.



4 Once the siding is removed, pry out cripple studs below window sill and remove any drywall or plaster from inside the room.



5 Slide the new tub enclosure through the opening, being careful not to scratch the fiberglass. Reinstall the framing and siding.

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Relocating A Toilet

REMODELING a bathroom may involve replacing a toilet with one that's larger or shaped differently. It could also entail installing a larger sink or tub that could end up crowding the toilet. Or, you may just want the toilet in a different location. The solution in each case is the same—relocate it.

The big job in changing a toilet's position or installing a new one involves changing or extending the waste pipe, water supply and the vent pipe, where applicable. The fixture manufacturer supplies measurements for the toilet offset—how far to set it away from the back wall to have adequate clearance for the tank. They also supply measurements for the waste pipe location. Keep in mind that these measurements are based on the distance from the *finished wall coverings*. So make allowances if you're working with an unfinished wall.

To remove the old toilet, turn off the water supply at the main shutoff valve and flush the toilet a few times to drain water from the tank and bowl. Use a sponge and bucket for any remaining water.

Disconnect the supply pipe at the



There's nothing written in stone about the location of any plumbing fixture. They are all movable, with varying amounts of difficulty. Here's what's involved in moving a toilet.



1 Begin by removing the nuts that attach the toilet to the hold-down bolts. If these are rusted in place, cut them off with a hacksaw.

tank. If the toilet is a 2-piece unit you can disconnect and remove the tank from the bowl. Keep the attaching bolts inside the tank from rotating while removing the nuts underneath the tank. Or, as with 1-piece fixtures, you can remove the toilet and tank as a unit. Remove the nuts at the base of the bowl that attach the bowl to the



2 Wiggle the bowl back and forth to break wax seal. Then get a helper and lift toilet off the floor flange. Remove from room.

floor flange. These nuts usually are rusted due to humidity from the shower so you may need to cut them off with a hacksaw. Rock the toilet back and forth to break the wax seal between the toilet and the floor flange. There still will be some water in the toilet trap, so lift the bowl straight up by the back and the rim



3 Remove the floor flange by heating with a torch. Then cut and pry up floor decking to expose waste line underneath.

then tip it and drain it into a bucket.

With the toilet removed you'll be left with a metal floor flange soldered to the waste pipe or possibly a plastic flange and pipe. (The plastic pipe is easier to work with. It can be cut readily with a hacksaw and new fittings and pipe are available at home centers and lumberyards. They are

joined with easy-to-use glue.) Remove the flange by heating it with a torch fitted with a wide heat spreader tip. Once the flange is off, stuff the pipe with rags and cover to prevent debris getting in or sewer gas getting out.

Layout

Using the fixture offset dimension, determine the new location of the waste pipe and open up the area by removing the flooring. Try to route new pipe between existing joists, maintaining a minimum downward slope of 1/4 in. per foot away from the fixture.

Next, remove the elbow below the flange by heating it with a torch to melt the solder and working it free with a pair of pliers. Sand off the excess solder and lay out your new pipe using a combination of elbows and straight connections to route the pipe to the new location. In extending the pipe, keep elbows to a minimum because they restrict the flow of waste and promote clogging.

If you have to cut out a section of joist, reinforce the floor by nailing headers between the two joists on both sides of the cut one. Line up and install the floor flange elbow so the bottom of the flange lip will be flush with the finished floor. Measure this distance from a level placed across the floor opening. If the flange is too high, the toilet will rock. If the flange is too low, the toilet won't seat properly on the wax seal.

To install the flange, coat the parts with flux, then heat the pipe and flange with a torch until the solder melts and creeps into the joint. Solder all the way around the joint and then use a rag to wipe the joint clean.

To extend your supply pipe, turn off the water at the main valve if you haven't already done so and relieve the pressure in the lines by opening the shutoff valve. Remove the section of your wall necessary to expose the pipe. Check the dimensions supplied

by the fixture manufacturer for the new pipe location. Then, sweat on the proper fittings and pipe nipples required to reach the new locations.

You can run pipe through studs or joists by boring through the center of the member. For joists, make sure the diameter of the hole does not exceed one-quarter of the joist depth. If a pipe hits the top or bottom section of the joist, you can notch the joist to one-third its depth. Reinforce a top notch with two 2x2s fastened on both sides of the joist below the notch. Use a steel brace fastened across the opening for a bottom notch. You can drill through wall studs if the hole diameter doesn't exceed one-half the stud depth.

Add a short section of pipe to extend through your finished wall. Install a shutoff valve by first slipping on the escutcheon, then threading the valve onto a male pipe adapter that's been soldered to the end of the supply line.

Venting

All toilets must be vented, usually through the main soil stack and sometimes by means of a secondary or separate vent pipe. If you are just moving your toilet a few inches, your existing vent will work fine. But if you are moving the toilet farther away, consult your local building codes for new venting requirements.

To install the new toilet, insert new mounting bolts in the floor flange and keep them upright with plumber's putty. Insert the wax seal in the floor flange with the tapered side facing up and line up the two mounting bolts on the toilet base. Lift the toilet over the bolts, press it down, then gently rock it back and forth to seat the wax seal onto the flange. Gently tighten the nuts on the mounting bolts, to prevent cracking the toilet. Attach the tank if you have a 2-piece toilet, and then connect your supply line using flexible tubing.

PM



4 Use whatever fittings are required to change location of waste opening. In this case, we moved the toilet 6 in. away.



5 The cold-water supply line must also be moved. Clean the required pipe sections and fittings, then coat with flux and solder.

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Exhaust Fans

MANY development or tract houses had bathroom exhaust fans installed only in interior bathrooms when they were originally built. Bathrooms on exterior walls relied on windows for ventilation. But it isn't always convenient to open a window, especially if you have central air conditioning or if it's cold outside. So adding an exhaust fan is a nice custom touch, and one that makes sense if you're going to be remodeling anyway.

How to buy

Exhaust fans can be vented to an attic or outside the house. Venting to the outside is superior because it prevents excess moisture from going into the attic, which may be difficult to dissipate in the winter.

Fans come in wall- or ceiling-mounted models. Capacity also varies. Your fan should be able to exchange the air in the room at least eight times every hour. To calculate the fan capacity for a bathroom having an 8-ft. ceiling, multiply the room length \times width (in feet) \times 1.1. If your installation uses a long run of ducting that bends around corners, allow extra capacity to overcome added resistance to the airflow.

Location

Mounting considerations should include a location that's as close to an outside wall as possible. Try for the most direct venting route. The fan will be more effective if mounted close to the shower so it can pull away moist

air. Don't position the fan over a heater or radiator where it will draw out your warm air. Mount the fan with the exhaust port aimed toward the exterior of the house.

While many models contain a light

that works off the same switch as the fan, it's a good idea to use separate switch controls so you can use the fan only when you need it. Why listen to the noise if it's not necessary?

Exhaust fans can also mount on the



Bathrooms are a humid environment, there's no doubt about that. But often these rooms were built without an exhaust fan to carry away the damp air. Here's how to install one.



1 Determine a suitable location and nail fan housing into a ceiling joist. Use roofing nails because their large heads hold better.



2 Cut holes through ceiling joists to accommodate exhaust hose. Carefully slide hose through holes to prevent tearing plastic.



3 Cut hole through exterior of house at proper location. Then slide hood assembly into hole. Nail hood flange in place.

wall attached to the studs, with the grille flush with the wall covering. Some models vent directly to the atmosphere without using a hose. Other models use ductwork connected to a roof cap or to a grille in the soffit under an eave.

The bath in this project was on the first floor, so we used a ceiling-mounted fan ducted through the joists and the outside wall. The fan mounts between joists using two mounting arms that nail into the joists. Adjust the fan height so it will be flush with the finished ceiling.



4 Slide support plate over hood pipe and push tight against joist. Then slide hose over pipe and attach with duct tape.

Installation

Connect the exhaust hose and route it to the exterior wall. In our case, the floor joists ran parallel to the outside wall, so we had to bore through all the joists, using a holesaw mounted in a right angle drill to run our 4-in. flex line. Bore through the wall sheathing and siding to install the exhaust pipe and fan hood. The exhaust pipe is installed from the outside of the house. If necessary, the 10-in.-long pipe is trimmed to size from inside the house after it is in place.

Screw the exterior fan hood to the house. Run a bead of silicone behind the flange to prevent leaks. Connect the exhaust hose to the fan and exhaust pipe and fasten both ends with duct tape.

Electrical hookup

For power, we installed a new switch box in the wall where we ganged two switches for the fan and light, and a ground fault circuit interrupter (GFCI) receptacle. This type of receptacle is required in bathrooms because of the moisture in the room. It prevents serious shocks as it is easily tripped by a slight change in current draw.

Junction boxes come in metal or plastic. We used a plastic box that

nails to the stud. Mount the box so it extends beyond the studs to be flush with the finished wall covering. The box is marked for specific depths. Our wall was to be covered with 1/2-in. drywall and finished with 1/4-in. tile. So we mounted the box at the 3/4-in. mark.

Splice into a junction box to run a feed line (hot, neutral and ground) to your fan box. Strip insulation from wire end and make all wire connections with wire nuts. Run the wires and staple them every 3 to 4 ft. along the center of the inside surface of studs and joists. Drill holes through the center of studs and joists as necessary to route the wires. If you have to drill near the end of a stud or joist, or if you have to notch a framing member for the wire, fasten a nailing plate (a heavy metal plate to protect the wires from nails and screws) over the notch.

Loop the wire before you bring it through either the switch or fan box, so if you cut the wire short you can pull more through. Staple the wire within 12 in. of both boxes and use cable connectors to clamp the cables in the metal boxes. The fan is wired similar to a light fixture, but be sure to check the specific manufacturer's directions that are packaged with the fan.

PM



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Medicine Cabinets And Recessed Lights



Mirrored medicine cabinets, a tradition in the bathroom, take advantage of space inside the wall. We installed three cabinets, side by side, for extra storage.

FOR YEARS, a lot of bathrooms were built without a medicine cabinet. They simply featured large mirrors, attached directly to the wall, and relied on vanities or shelves somewhere else in the room for storage. While this can provide a clean, tailored look, it does have one shortcoming: A medicine cabinet is the handiest and safest place to store dangerous things away from children.

For our project, we installed three recessed medicine cabinets centered over a vanity. Many medicine cabinets are designed to fit between existing studs which are spaced usually 16 in. on center. Oversize units, such as we installed, require cutting and removing one or more studs.

Layout

Start by determining the rough opening location based on the height of the vanity countertop and the height of the cabinets. Rough opening dimensions are arrived at by laying the three cabinets facedown on the floor, leaving $\frac{1}{4}$ in. between them for door clearance. The doors are wider than the cabinets themselves so there will be ample room to frame out the rough opening for the individual cabinets without adding the framing thickness to the overall rough opening measurement. Position the cabinets so all the doors swing open the same way. Measure the total width and height and add $1\frac{1}{2}$ in. to the top and bottom to allow for 2x4 headers.

Installing a new header

If you're cutting into a bearing wall, you'll have to install a header to carry the weight. To do this, you must first construct a temporary support wall to hold the ceiling in place while you work on the wall. Build this support wall so it's at least as long as the header you must install. Use single 2x4s for the top and bottom plates and 2x4s for the studs. Nail the studs to the plates on 24-in. centers and make sure the wall is just a bit longer than the distance from the floor to the ceiling.

When the wall is fabricated, lift it in



1 To install three cabinets, frame the opening so there is enough room between each for the mirror to swing. Then cover the framing with the same wall covering used elsewhere.

place being careful not to damage the floor or ceiling if you don't plan to replace them. Position the support wall as close to the medicine cabinet opening as possible and still have room to work. Three feet away will work fine. Then cut a double 2x8 header for above the opening. Support it with a jack stud on both ends, and add any necessary blocking between the header and the top wall plate.

Transfer the cabinet dimensions to the wall, using a level to mark the top and bottom lines. Mark your vertical lines along the center of the nearest

studs. Cut and strip the wall to expose the studs, taking care not to cut into electrical, plumbing or duct work. Cut the studs with a reciprocating saw and remove the sections from the rough opening.

Frame out the rough opening by nailing in your header and bottom 2x4 sill. Toenail them to the studs with 8d or 10d common nails and also nail through the header and sill into the ends of the cutoff studs. Install vertical 2x4 framing between the header and sill to achieve your finished rough opening. Make sure your verticals are

plumb and that their inside edges are flush with the inside edges of your jack studs.

Work from the center of the rough opening to determine the location of your cabinet divider framing to create three separate rough openings. We covered our framing members with plywood because our finished wall covering was wood flooring which we glued to the plywood wall. But you can use drywall or plaster depending on the existing finish on your walls. Just keep in mind that you want the surface to be smooth and to extend into the room the same amount as the surrounding wall surface. (If you are covering the wall with wood, like we did, cut the wood flooring to the size of your finished opening and then install it.)

Set the center cabinet first. We used drywall screws rather than nails so the cabinets could be easily removed later if necessary. Also, an errant blow with a hammer—when driving in nails—could bend the cabinet and prevent the door hinge from working properly. It could also break the mirror. Test fit the other medicine cabinets and shim them as required. Don't over tighten the mounting screws to avoid distorting the metal cabinets.



2 Slide first cabinet in place and check for plumb. Screw into framing. Hold second cabinet in place and check for mirror swing.



3 Attach all cabinets to framing using drywall screws. Screws allow cabinet to be removed without damage.

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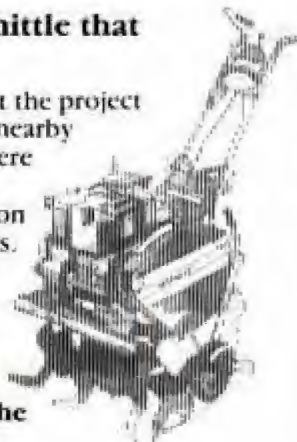
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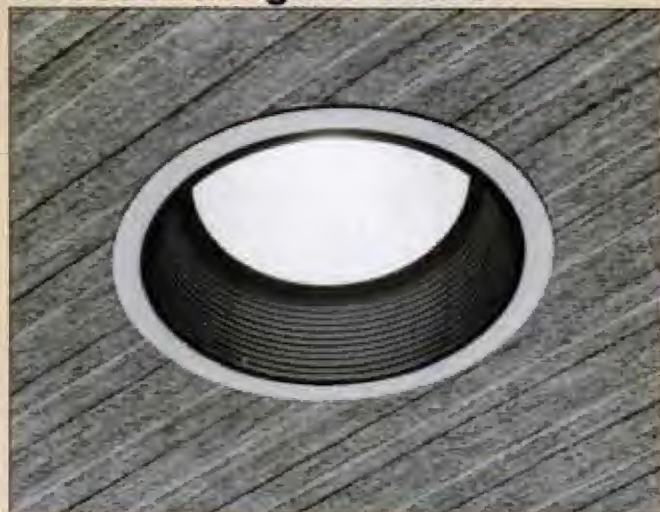
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Recessed Light Fixtures



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Recessed spot lights let you custom design the lighting in any room.

RECESSED light fixtures are installed in the framing, either in the wall or ceiling. The ceiling fixture we used is called a high hat. It looks like a can and comes in a variety of sizes and shapes.

The typical high hat uses a 150-watt bulb and can illuminate about a 12-ft. area. Determine the fixture location by your preference of what areas you want to illuminate and intensity of light you feel comfortable with. In our application, we installed the lights in the center of the room.

These units come with spiked extension arms that nail into the ceiling joists. Keep the lights at least 3 in. away from insulation to allow cooling air to circulate.

A built-in junction box makes wiring easy. Bring your feed cable through a cable connector installed in a knock-out hole in the box. And make normal light-to-wall-switch connections. Then cover the ceiling with your finish material, making the proper cutout for the fixture. A trim ring completes the installation. **PM**

1 Determine the best location for the light, then slide it between the joists and drive nails through the mounting bracket.



2 Install cable connector in light box, feed cable through and tighten. Have electrician make final wiring connections.



Metal Laminate

ONE OF THE VERY glamorous and high-end custom looks of today is a bathroom where the walls and ceiling are totally mirrored. But mirrors are fragile and can crack. Banging open a door or knocking into the wall while vacuuming can have disastrous results. And, of course, you can't patch glass like you can drywall or plaster.

An alternate way to achieve a similar effect is with aluminum laminate. This product uses aluminum facing bonded to a plastic laminate base. It comes in the same thickness as traditional laminates— $\frac{1}{32}$ in. or $\frac{1}{16}$ in. The surface is shiny and reflective, although not as crystal clear as a glass mirror. Aluminum laminate is usually used in commercial applications—specifically restaurant kitchens where it is easily wiped clean. Applying it in a home bathroom is another uncommon application of a common material for a distinctive custom effect.

Before applying metal laminate, the walls have to be plumb and square. If yours aren't, strip the walls down to the studs and shim out studs to achieve a reasonably square room. Install $\frac{3}{8}$ -in. A-C plywood, with the smooth side facing into the room, by screwing it to the studs. Recess and spackle the screwheads and then sand them down for a flat surface. Likewise, fill in and sand the joints between panels.

Metal laminate comes in 4 × 10-ft. sheets and can be applied horizontally or vertically. The sheets butt and the seams are covered with contrasting

color batten strips. For our project, we used black metal laminate with chrome batten strips. The number and position of batten strips depends on how you install the panels.

Plan your layout of the entire room

on graph paper. The tricky part is lining up the ceiling battens with the wall battens. You want the effect of a planned design, something that doesn't look too busy. Work with the walls and ceiling as a unit to avoid an



Plastic laminates have been around for quite a while. But now some have metallic skins, like the aluminum panels above, which can yield stunning results when used on walls and ceilings.



1 Begin by covering studs and joists with plywood. Fill seams between panels with joint compound. When dry, sand smooth.



2 Begin on the ceiling by snapping a chalk-line where you want the edge of the first panel. Plan your layout to minimize joints.



3 Cut and check each panel for fit, then apply contact cement to plywood and laminate. Carefully align panel, push in place.

unsightly jigsaw effect. Determine the number of sheets you'll need, allowing for any waste. Transfer your layout directly to walls and ceiling using a level and chalkline.

Installation

Install the ceiling panels first. Cut the sheets according to your layout with a router and straight edge guide (a straight piece of wood will do). Cut the sheets about $\frac{1}{8}$ -in. short all around to give you some leeway in ap-

plying and adjusting the sheets. The gap will be hidden by the battens.

Apply three coats of nonflammable contact cement with a roller or brush to the plywood ceiling and the back of the laminate. Let each coat dry before applying the next. Adequate ventilation is very important because of the cement fumes. A water-based cement also is available. It eliminates the fumes but takes much longer to dry. In any case, be sure to wear a respirator with appropriate vapor filters.

Lay out and mark the position of the batten strips on the ceiling and walls using a level and chalkline. Test fit the battens before cementing them in place. Install them the same way as the aluminum sheets and wipe away excess cement with lacquer thinner. If you choose the horizontal layout, like we did, first apply the batten strips around the ceiling and then around the floor. Apply the vertical batten strips in the corners and, lastly, the horizontals in the mid wall. **PM**



4 Because no room is absolutely square, cut wall panels slightly oversized, then hold in place and scribe to fit the ceiling panels.



5 A router is the best tool for rough cutting laminate. Align cut mark on panel with edge of bench and cut with straight pilot bit.



6 Once each panel is in place, carefully roll entire surface with a laminate roller. This ensures the best bond and a smoother surface.

Custom Mirrors

ANYONE can buy and hang up a mirror, but for a really integrated custom look, build your own. You can color coordinate the mirror frame or surround, and have the glass part of the job fabricated by a glass shop. You can create the custom effect by working into the mirror frame the same laminates used for your vanities, or those on your walls.

The first step is to determine the size and shape of your mirror. For our project, we decided that a round mirror would look best over our pedestal sink. The frame is $\frac{3}{4}$ -in. pine or birch plywood, covered on all sides with the same laminate used on the vanity.

Make a template for your frame and transfer the inside and outside circles to your sheet of plywood. Cut the frame using a jigsaw and router, then cut two strips of laminate, about $\frac{3}{4}$ in. wide and long enough to wrap around the inside and outside circumferences of the frame. Butt the ends of the strips at the bottom of the frame and glue them in place with contact cement. Let the adhesive cure, then sand down the laminate edges until they are flush with the front and back surface of the frame.

To laminate the face of the frame, use the frame as a template to trace your circles onto the back of a laminate sheet. Apply contact cement to the back of the laminate and the face of your frame and push the two together. Trim the extra laminate with a router. Turn the frame face down and route a groove for the glass. Use a piloted rabbit bit and cut the groove a little deeper than the thickness of the glass.

At this point you can silicone your glass into



You can also use metallic laminates to make custom accessories like this high-tech mirror.

the groove and hang your mirror. But we wanted to get a more interesting custom look. So we embellished the frame with decorative laminate-covered blocks. You can't glue the blocks to the frame because the cement won't

adhere to the laminate's glossy surface. So all the blocks are fastened with screws from the back of the frame. The last step is to attach a hanger. Two eyehooks and a strand of wire do nicely.



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PHOTO 1



PHOTO 2



PHOTO 3

These are identical miniature buildings made of plastic with galvanized metal roofs. Heat sensors have been fastened to the inside of each roof and attached to digital thermometers. A 600 watt photo lamp is located midway above and at equal distance from each model. The roof on the left is painted with ICC's paint; the other with high quality reflective white building paint. Photo #1 shows under roof ambient temperature before test lamp is turned on; after two minutes with bulb on (Photo 2) shows a 29.3 degree difference and after three minutes the difference is an almost unbelievable 40.4 degrees. This is a demonstration test you can do in your customers' living room or office. Imagine the impression — and sales this demo will make for you.



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PEOPLE who are remodeling nowadays are looking for those unique touches that make a room distinctive. One approach is to use a common material in an uncommon way. An example is installing Bruce hardwood flooring on walls and ceilings. As is often the case where products are used outside their usual application, special installation techniques are necessary.

Preparation

The first step is to install a suitable subsurface to hold the wood. Drywall can work, but it's less than ideal. You can also install blocking between all the studs and joists. This blocking should fall every 2 to 3 ft. to provide adequate nailing for the boards. This can be pretty time-consuming. Another option is to install furring strips across the studs and joists for nailing purposes. While this is easier to install, it also requires that you remove all the casing and baseboard because otherwise the surface of the finished boards will extend beyond them. And, you'll have to add extension jambs to the windows and doors to make up the difference. So in the long run, furring is a poor option.

We stripped the walls and ceiling



Prefinished wood flooring comes in many styles designed for d-I-y-ers. Though usually seen on floors, it's also great for walls and ceilings.

down to the rough framing and covered them with plywood sheets to give us a firm foundation for our mastic. If there is a finished wall on the other side of your framing, use screws rather than nails to install the plywood. The pounding action of nailing can damage the finish on the other side of the wall.

Plan the layout of each sheet and take measurements from the floor and rough framing on the walls and ceiling for the location of protruding pipes, openings for lights, fans, cabinets and so forth. Transfer the measurements to the plywood and cut the openings a bit oversize to give you some leeway in your installation.

Adjust the plywood sheets on the walls with a prybar to avoid catching your fingers. Start with the ceiling first as the sidewall sheets help support the sheets on the ceiling. Cover your sidewalls working from the ceiling down to the floor.

The wood flooring can be applied in either of two ways. The manufacturer supplies a mastic that is applied to the subwall with a toothed trowel, and the wood strips are pressed and tapped into position. Or, you can nail the flooring onto the plywood sheathing with 4-d finishing nails. Hold-



1 In any remodeling job when you have to remove wall covering, it's a good idea to upgrade insulation in exterior walls.



2 When installation of all mechanical systems—plumbing, heating, electrical—is complete, cut and screw plywood to walls.



3 Apply proper mastic to plywood sheathing using a notched trowel. Be sure to follow manufacturer's directions carefully.

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HOME IMPROVEMENT GUIDE

ing power for each method is about equal. You can also apply it vertically, horizontally or diagonally.

Installation

To get a tight fit between strips, take a scrap piece of tongue-and-groove board and lay it on the edge of the strip you're installing and tap it until the joint is tight, using a rubber mallet. You'll get a nicer effect in the inside corners if you do not use molding. Cut the pieces to fit. If your last strip has to fit a 3-in. space, for instance, scribe it to 3 1/4 in. and plane off the extra 1/4 in. Cut a slight back angle so the piece will slide into position easier.

You can cut your flooring with a miterbox or a chop saw fitted with a carbide blade. The chop saw is faster and the blade won't dull, chip or burn as quickly as a high-speed steel blade.

Cover the sidewalls working from the floor to the ceiling and starting at either the right or left corner. Measure ceiling openings (for lights and fans) from sidewalls and transfer the measurements to your flooring. Cut the flooring so it extends right up to the opening, or allow a slight excess and trim to fit. Butt the flooring right up to the door and window jambs. The flooring installs on the ceiling in the same manner as the walls.

We made one of our sidewalls a feature wall by installing strips at a 45° angle. Cut your corner piece at a 45° angle on both ends. Start from a bottom corner and make sure the tongue is facing upward. Tap the joints tight with a scrap tongue-and-groove board and continue until the wall is complete.

You may well find that it is a better idea to use two boards for each row, when you are working diagonally. This allows you to fit each miter precisely before you make the square end cut, instead of making a perfect miter on both ends of a single board.



4 Press cut boards firmly into mastic, then tap joints together with a rubber mallet. Use small scrap block to protect tongue.

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Ceramic Tile, Everywhere

CERAMIC tile is commonly used in bathrooms for floors, and often for walls—especially in shower enclosures. For a really custom look, consider tiling the entire bathroom interior, including the ceiling. Tiling a ceiling actually is not much more difficult than tiling a wall. The tile is applied to the mastic in the normal manner. The glue is strong enough so the tile won't fall. The trick to tiling an entire room where all the grout lines are lined up along floor, walls and ceiling is careful planning. Determine beforehand exactly how all the tile will be laid out and where your cut tiles will be least conspicuous.

The first consideration is the squareness of your room. If it's way off, it will be almost impossible to get the tile to line up. So go to Plan B—an alternate layout that will hide the room's problems.

Tools you'll need for the job include a portable tile cutter, wet saw, tile nippers, 2- and 4-ft. levels, chalkline, finishing stone (to smooth sharp edges on cut tiles), notched trowels (to apply the mastic), a small margin trowel, a rubber float (for spreading grout), sponges, towels and a scoring stick.

Tiles are glued to drywall on walls that are not exposed to direct water. For wet-wall application, like in a shower, tile is set on Wonderboard



Ceramic tile is an excellent building material, especially for bathrooms. It's durable, easy to clean and waterproof, plus it comes in a wide variety of colors and styles.



1 Begin layout by marking a reference line near middle of room. Plan layout so perimeter tiles will be same width on both sides.



2 Spread mortar or adhesive on floor using a notched trowel. Stop at layout line, so line is still visible when you put the tile down.



3 Set tile by giving each a small twist before abutting layout line. Tiles have small alignment ears on all sides for proper spacing.



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with a thin-set cement in between.

For our project we used standard 8-in.-sq. tiles. They come with small ears on all sides for spacing.

Your starting point determines the position of all the tiles, so plan various layouts on graph paper to see how the tiles will fit around windows, fixtures and so on. Once you establish your starting point (begin with the longest, uninterrupted wall), draw a level line across the entire wall.

Apply mastic with the notched trowel. Different types of notched trowels apply different amounts of mastic. The trowel to use depends on the back surface of the tile. Check your tile supplier for choice of trowel.

Setting the tile

Press the tiles into the mastic firmly without the glue squeezing out the sides. Once you've set the initial two full rows of tile, fill in all your full tiles on the wall. Cut tiles are set later. If your initial rows are set true to your level line, your succeeding rows should be square and plumb.

Now set your cut tiles, adjusting the cut as necessary for any out-of-squareness of the room. The portable tile cutter uses a carbide wheel to score the tile. Handles on the tool exert pressure on both sides of the score line to snap the tile. Remove the sharp edge with the finishing stone. Most tile mastics dry in about 25 minutes, so do a small section at a time.

Start your second wall by setting a level against a joint between tiles. Draw a level line across the wall and set two rows of full tile straddling the line in the same manner as the first wall. To get around pipes, use the tile nippers to bite out pieces of tile. Tile around corners (we had to tile a shower wall that had two corners extending down the sides of the enclosure)

by using bull nose tile. To get around a window, work off your original level line, setting the full tiles first and then the cuts. Make cuts with the wet saw, which is a rental item, for the window corners.

When you finish setting a wall, sponge off the excess glue before going to next wall. Wipe the face of tile and use the edge of your finger to knock down any glue that's come up in the joints. Glue gets darker as it ages and will eventually show through the grout.

Ceiling and floor

When your four side walls are complete, start on the ceiling. Strike chalklines off tile joints on the side walls and start setting tile where the chalklines intersect in the center of the room. You'll have to adjust the tiles as you go along depending on how far your ceiling is out of square.

At this point you can either grout your tiled walls or tile the floor. We did the floor first. We selected the same style tile for the floor as the walls. The difference is that the floor tiles have a nonslip matte finish. Tile application depends on your type of floor. We were working with a concrete slab which requires a thin-set mortar base instead of mastic. The mortar is mixed with water, compared to the mastic which is used right out of the can.

Snap chalklines across the floor for the tile joints. Since you'll be working yourself out the door, you have to set your cut tiles as you go along, rather than setting them after your full tiles are in. Work as much of the floor area at a time as you can reach. Apply mortar carefully making sure you don't cover your working lines. You can fill any gaps by also applying mortar to the backs of the tiles.

Before you apply the mortar, be sure to clean all the dust off the floor. Apply a thin skim coat of mortar with the back—smooth side—of the trowel. Before the mortar dries, apply another layer with the toothed side of the trowel. Don't cover your working lines. Then apply a thin layer of mortar to your tile and set it.

Grouting

Tile grout differs between wall and floor applications. Floor grout contains sand for durability where wall grout does not. Grout is basically a portland cement with color added. It is mixed with water and can be used with a latex additive that helps resist cracking when the grout hardens.

Mix the grout to a creamy consistency, and let it sit for about 15 minutes. This softens the mixture and dissolves the lumps. Then whip it up one more time. Scoop out the grout with a margin trowel and apply it with the grout float—basically a square piece of rubber with a handle. Apply the grout at a 45° angle to force it into the joints, working a small area at a time. Then go back and use the edge of the float to remove the excess grout from the surface. The grout has a definite working time which depends on climatic conditions. If it's too wet it will wipe out of the joint, if too dry it will be hard to remove the excess.

Use the scoring stick (similar to a Popsicle stick with a blunt edge) to go over all your grout lines—first the vertical lines, then the horizontals. This packs the grout all the way in and cleans up the joint. Use a clean, damp sponge to wipe off the tile face and joints. Keep the sponge clean by rinsing it in a bucket of clean water. Wash the tiles a second time in cold water to bring out the shine, and then buff the surface with a clean, dry rag. **PM**



4 To measure perimeter tiles, lay tile to be cut over last full course. Push next tile against wall and scribe top tile for perfect fit.



5 Make straight tile cuts with tile cutter, an inexpensive rental item. Cutter scores tile with sharp wheel then snaps tile in two.



6 Make irregular cutouts with tile nippers. Simply snip off small pieces of tile until you get desired shape. Do not take big bites.

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Custom Vanities

HOME centers may offer a variety of bathroom vanities, but if you're going for a total custom look, the prefab vanity route may not be the answer. Building—or having someone build—and installing your own custom vanities have several important advantages. If you are redoing your bathroom and emphasizing color coordination, it is possible to get the exact color you want to custom match or contrast with the rest of the room. Also, production vanities are built to standard dimensions and are made to accept standard-size fixtures. These limitations don't apply when you're dealing with custom designs.

Planning

Plan your vanity by determining decor and style, type of countertop and any special features such as shelves or a built-in hamper. Decide on the type of drawers, doors and hardware you want for the cabinet. You can't plan your vanity without first knowing the size of your sink or sinks, so you can make the countertop large enough and the vanity deep enough so everything will work out. Measure your space carefully and make sure you have adequate clearance space from shower walls, toilet and tub. Standard vanities are 21 in. deep. You can use this dimension as a starting point in your planning and modify from there. Select your materials at home centers, kitchen/bath design centers and lumberyards.

Laminated vanities are usually

made of flakeboard or particleboard. MCP (melamine coated panel) board is an excellent vanity material. It comes with a thin laminate coating on both sides. Available in various colors, MCP boards make an ideal finished surface for your cabinet

interior. The cabinet exterior also can be MCP but you have more flexibility if you apply laminate.

Plan the cabinet construction on graph paper. Use $\frac{1}{8}$ -in. MCP board for the cabinet and $\frac{3}{8}$ or $\frac{1}{2}$ in. for the doors. We used the heavier board for



A well-designed vanity can make your morning ablutions pleasant and convenient. You can either custom design and build your own, or choose from a wide range of stock versions.



1 To install the vanity, first lay out the back side of the case with the precise location of your supply and waste plumbing pipes.



2 Bore small pilot holes from back into vanity compartment. Then bore proper-size holes from inside out to prevent splintering.



3 Install the faucet and flexible supply lines to the sink before lowering in place. Also, assemble the drain stopper lift lever.

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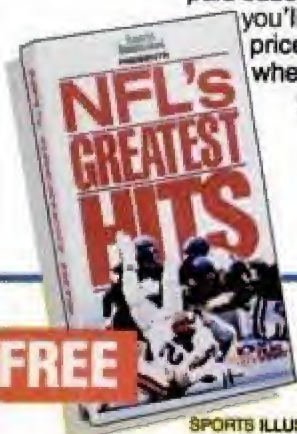
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HOME IMPROVEMENT GUIDE

our doors because of the concealed European hinges that require the extra door thickness.

Cut your materials and glue, nail or screw the unit together. Apply the exterior laminate over the MCP using two or three coats of contact cement on the MCP and laminate. Trim the excess laminate during assembly, using a router with a straight pilot bit. Dress the finished edges with a beveled laminate bit.

Construct your drawer and door fronts. Build your drawer boxes using MCP and finish the top surfaces of the drawer and door sides with edge-band tape, which is available in the same colors as MCP board. Iron on the tape and trim off the excess by sanding with fine paper. Laminate your door and drawer faces. Drawer slides come in different designs for different applications. We chose a lip-mount epoxy-coated unit made by Blum.

We used the same MCP board for our floor and back as for the sides. Dado the sides and back of the cabinet to receive the floor. Glue and nail the floor in place. The toe-kick mounts underneath the cabinet and extends from side to side. You can glue nailing blocks behind the toe-kick to stabilize the board in the center of the cabinet.

Apply laminate to the countertop before cutting the holes for the sink. We used laminate that matched the cabinets, made by Wilsonart as part of its color coordinate program. The sink manufacturer supplies templates for the basin holes. Cut the holes with a fine-tooth jigsaw. Lay out and cut holes for your faucet, and attach the backsplash to the countertop.

Before you set the vanity in place, bore holes in the back or floor (depending on whether your pipes come out of the wall or floor) for the plumbing. Measure the pipe locations and transfer the dimensions to the back of

the cabinet. Bore pilot holes at the center of the pipe locations from the back of the cabinet. Then bore the full-sized holes, from inside the cabinet, using spade bits or holesaws. Mount the vanity, without the countertop in place, by screwing it to the wall studs. You can mount the sink into the countertop before installing the counter on the cabinet or afterwards, if you prefer. But in either case, be sure to run a bead of silicone caulk around the sink flange before inserting the sink. Also, attach the faucet and drain hardware now, when it is all easily accessible.

To mount the faucet, use the gasket supplied or a bead of plumber's putty under the bottom edge of the unit. Attach flexible supply lines to the bottom of the faucet.

Many vanity sinks are self-rimming—the rim of the basin extends beyond the cutout and rests on the countertop. Flush mount sinks, on the other hand, fit into the lip of a stainless steel mounting ring which borders the sink on the countertop. To install these, first mount the ring on the sink applying silicone caulk between the ring and the top. Then apply silicone to the sink's edge so it will seal the joint between the ring and the sink flange. Position the sink in the hole and install mounting clamps.

Recessed sinks mount below the counter surface and attach to the underside of the countertop. In this case, the inside surface of the cutout has to be laminated because it is exposed. Undermount sinks attach to the counter before it is installed on the cabinet. Turn the countertop over, apply silicone to the sink top, and line up sink in the cutout.

Once your sink is installed, hook your water supply lines to the shutoff valves and add your trap between the sink tailpiece and waste line. **PM**



4 Apply silicone caulk around perimeter of sink opening, then lower sink into place. Center in opening and wipe away excess caulk.



5 Use trap and tailpiece to attach sink drain to waste pipe. Then connect supply lines to shutoff valves on hot- and cold-water pipes.

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PM HOTLINES

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RESTORING FADED PAINT

BY PAUL STENQUIST

IT'S BEEN a long cold winter, and you've been curled up, warm and dry, at the hearth. Your car, meanwhile, has been outside taking it on the chin. And it looks it. A little neglect (Hey! It's too cold to wash the car!) and a lot of acid rain and road salt have dulled your machine's once-brilliant shine. Your mission, on the first warm day of spring, is to resurrect that paint job.

Ultraviolet rays and corrosive salt fade and discolor the surface of automotive paints. Usually, however, the damage is only superficial. By removing the top layer of paint with a product that is compatible with the type of finish on your car, the original luster and color of the finish can be restored.

Resurrecting even a severely dull and faded paint job is certainly within the realm of things possible, but there

are limits. First, the more faded and oxidized the surface, the harder you'll have to work to refurbish it. Second, if the layer of paint is too thin, you may rub all of the finish off before you find good paint. Of course, with a complete repaint being the only viable alternative, you have little to lose.

Dirt removal

This procedure, largely unknown to owners of cars with severely damaged paint, is known as "washing the car." For some of us, it's a drastic measure but a necessary one. It's also a practice you'll want to continue after the paint has been restored as it helps remove airborne chemicals and muck before they damage the surface.

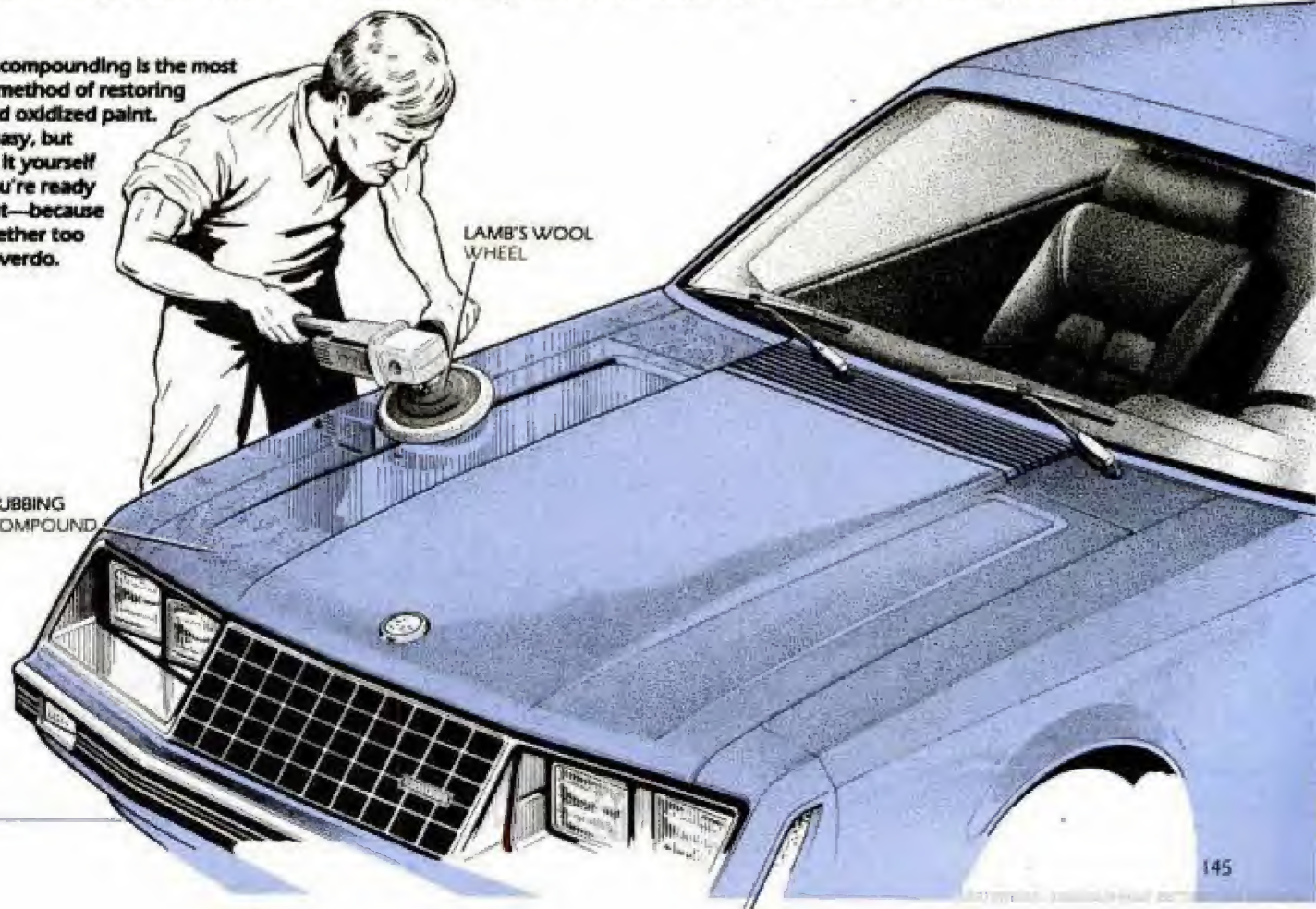
Do a thorough job, using a non-detergent soap that won't remove more oil from the paint. When washing a

car that has already been waxed, this type of soap will not remove all of the wax—heavy detergents will. Soaps that are specially formulated for washing cars are available at most auto parts stores. One of our favorite nondetergent soaps is the widely available Murphy's Oil Soap. Liquid soap made for washing dishes by hand is okay, but it may remove some oil. Don't use liquid or powdered laundry detergent.

Before washing the car's body, blast the wheel wells and underbody with a strong stream of water to remove road salt and other corrosive substances. If you're working at a carwash with a high-pressure wand, you can begin by spraying soap underneath, then rinse it off. After cleaning the underside, check for corrosion. And, if you find potential rust spots

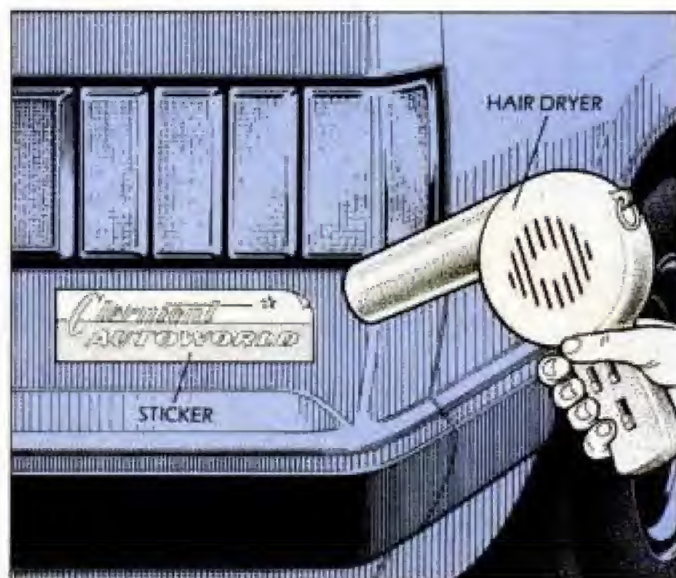
Machine compounding is the most efficient method of restoring faded and oxidized paint.

It looks easy, but don't try it yourself unless you're ready to repaint—because it's altogether too easy to overdo.





1 Nondetergent soap removes dirt and restores the paint's shine.



3 Sometimes hot air helps loosen stickers or woodgrain vinyl trim.

under the car, clean them up and apply an aerosol rustproofers.

Wash upper body surfaces in the shade. Have a hose on hand with a shutoff nozzle. Mix the soap in a bucket of lukewarm water. Use a big sponge and apply soapy water liberally (Fig. 1). Wash the roof first. Once the roof has been thoroughly cleaned, rinse it (Fig. 2) before proceeding with the hood and deck lid and, finally, the bodysides and the front grille area and rear panel. Rinse every time you finish a section, so the soap doesn't have a chance to dry. Each time you rinse, rewet the surfaces that you rinsed previously. If you're rinsing or soaping up with the high-pressure wand at a commercial car wash, keep it well away from the painted surface.

Here's how to use a chamois to dry the car thoroughly. Soak the chamois in water for a few minutes and then

wring it out completely. As you wipe up water from the surface, wring the chamois out from time to time. As you work, you can tell when the chamois is saturated as it will begin to leave droplets on the surface. Once your paint has been restored, drying your car with a chamois is just about all you have to do to restore the luster.

Once the car is dry, check carefully for remaining spots of tar or other foul muck and remove same with a rag and a bottle of bug-and-tar solvent. This chemical cleaner is available at most auto parts stores. If the rear panel and bumpers are defaced with old peeling stickers, now would be a good time to remove them, as you'll probably be able to blend in the paint underneath them (which is less faded than the rest of the car) when you compound or polish. A hair dryer can sometimes help loosen the sticker's adhesive (Fig. 3).

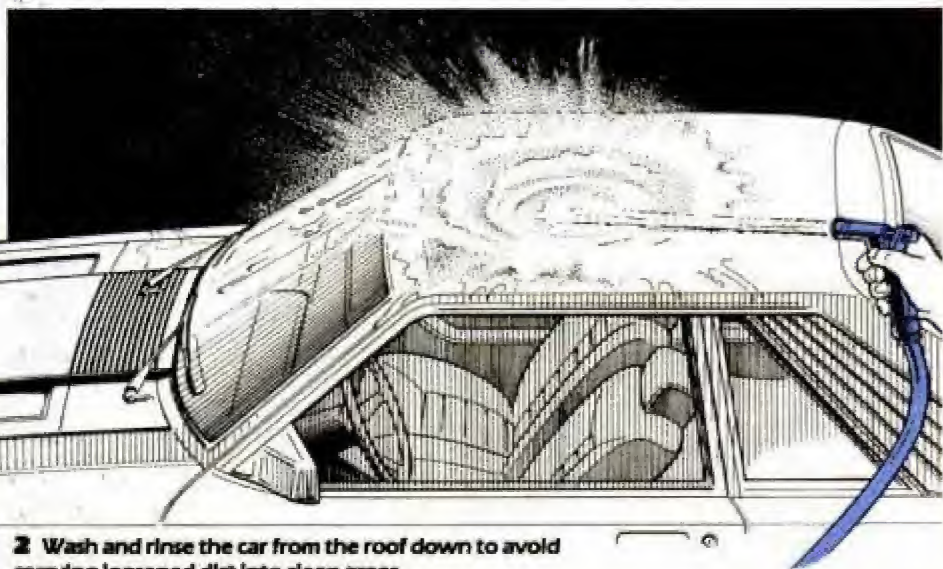
Assessing the damage

With all road dirt removed, you can evaluate the condition of your car's finish. How you deal with various problems depends, in part, on what type of paint was used to finish the car. If it's metallic without a clear coat on top, avoid using any type of abrasive cleaners. Metallic paint surfaces are not uniform from top to bottom—so if you rub off the top layer, you'll be left with a mess. A nonabrasive polish, used before waxing, can remove dirt and oxidation without removing paint. But don't confuse nonabrasive polish with polishing compound. Any product referred to as a compound or cleaner wax contains abrasives that can ruin metallic finishes.

An example of a nonabrasive polish that is suitable for metallic finishes is Turtle Wax Metallic. Most other manufacturers of automotive wax sell similar products that are marked as suitable for metallic finishes.

Depending on the thickness of the top coat, clearcoat/basecoat finishes can sometimes be damaged when abrasive cleaners are used. If you remove all of the thin clearcoat over the base, a respray will be necessary. While these finishes aren't as susceptible to damage as the conventional metallic types, they still call for caution. Don't use an abrasive polish if you can restore the sheen with a nonabrasive. If you must use an abrasive to restore your clearcoat, try a cleaner wax rather than straight polishing or rubbing compound.

If your car has a finish other than metallic or clearcoat/basecoat, you can usually restore its original luster with polishing compound or rubbing



2 Wash and rinse the car from the roof down to avoid carrying loosened dirt into clean areas.

compound. These products actually grind off the top layer of paint, leaving like-new paint below. In some cases where aggressive paint removal is necessary to restore a nice finish, you could end up removing too much paint—even if you're careful. But if your paint is in really bad shape, repainting might be the only alternative anyway.

If your paint is just slightly dull but has a relatively smooth surface, hand polishing will probably be sufficient to restore the luster. There are a number of polishing compound products available on the shelf of your neighborhood auto parts store that are intended for hand application. These usually differ from machine-applied products in that they are much more liquid and not as difficult to remove. They are not likely to remove too much paint as their abrasive power is limited by the application method.

Not all manufacturers use the same nomenclature for their products. For example, polish and polishing compound are usually not the same thing. Some products described as polish contain no abrasives and can be used on clearcoat paints—others may be nothing more than polishing compound in a more liquid form. Some have names that confuse the distinction. So don't rely on the name alone. Make sure you read the label before purchasing polish or polishing compound. If the label doesn't tell whether abrasives are included, rub some onto a painted surface (not necessarily your car) and look for color to be transferred to your cloth.

If the paint is severely faded and its surface resembles primer or is heavily scratched, compounding will be necessary. The product used for this operation is called rubbing compound. For the inexperienced, compounding is probably best done by hand, but it's a big job. Some of the rubbing compound sold in retail auto parts departments is intended for hand application only and should not be applied by machine, as severe rub-through can result. Rubbing compound for hand application is available in both paste and liquid form. Liquid types are easier to use, but you won't get as much compound for your money.

Machine compounding is easier and faster than hand compounding—but chances of damaging the finish are in-



4 Before you compound, use masking tape to protect raised edges.

creased considerably. It's not a job recommended for the uninitiated unless the only alternative is repainting.

If you do decide on machine compounding, use rubbing compound specifically formulated for machine application. You can buy it at an auto parts store that specializes in body shop supplies. It will be available in different abrasive grades, and if you're trying machine compounding for the first time, use a light grade, which will cut more slowly.

The counterman can also help you select the right type of polishing pad. A lamb's wool pad is most often used for compounding. You'll probably need two to finish the job. You can rent a power polishing machine at most tool rental stores.

Hand polishing

Whether you're using an abrasive hand-applied polishing compound on

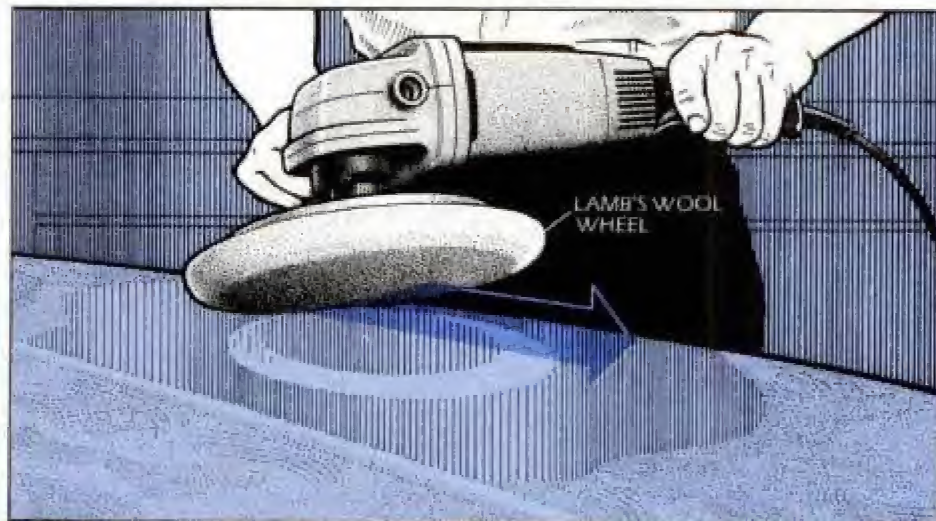
faded conventional paint or a nonabrasive polish on clearcoat or metallic paint, work in the shade or wait for a cloudy day. Apply the polish to a small area—about 2 ft. sq. If an applicator pad didn't come with the polish, use a piece of soft terrycloth. The instructions on the product package may tell you to dampen the applicator.

If you're using abrasive polishing compound, you should start to see some of the removed pigment on your applicator. Work with a very light touch when polishing edges. It's easy to rub right through the paint on a raised edge. Use a clean, soft, terrycloth rag to buff the surface.

Hand compounding

As noted above, hand compounding is hard work. A lot of elbow grease is required to do the job right. Do a 2-ft.-sq. area at a time. If the damage is severe and includes relatively deep scratches and substantial discoloration, begin by lightly wet sanding the area with 600- or 800-grit wet-or-dry sandpaper folded into quarters. Keep the paper fully saturated with water and don't get carried away. This is not recommended for clearcoat/basecoat or metallics, or unless you're at the last-resort stages of trying to rescue a loser. Before you begin, apply a thin strip of masking tape to raised edges and creases.

Apply the compound with a soft terrycloth rag that has been folded into a pad. Or, if the product came with an applicator pad, use that. Using medium pressure, apply the com-



5 Hold the leading edge of the pad slightly above the surface of area being compounded.

pound with straight back-and-forth strokes (Fig. 4). Following the directions, remove the compound with a dry rag.

If the surface isn't glossy once the compound is off, you haven't removed enough paint, and should repeat the compounding part of the procedure.

Once you've finished all other body parts, remove the masking tape from the edges and creases and compound these areas. Avoid applying compound with any significant degree of enthusiasm on raised edges to avoid rub-through. If you do rub all the way through the paint, refinishing is the only satisfactory fix.

Machine compounding

As we've already said, rub-through is a considerable risk when compounding a car using a professional polishing machine. However, machine compounding is much faster and considerably more effective than hand compounding. So if your paint is a total disaster and you're not willing to spend what *could* be all weekend trying to compound it by hand, you might want to do the job the way the pros do it. Remember, however, that machine compounding removes quite a bit of paint and if the paint is thin, you may have to repaint the car.

Make sure you wear old clothes, as the compound will fly all over when you turn on the machine. You'll also need safety goggles and a dust-type respirator. These are not optional. Compound can seriously damage your eyes and lungs. Don't take chances.

Before you begin, take some pre-

cautions to prevent rub-through. Since raised surfaces rub through first, apply a thin strip of masking tape to creases, raised edges or sharp corners on painted surfaces of the body. This will help reduce the likelihood of excessive paint removal.

When you're ready to start, read the instructions on the rubbing compound package and mix the paste with water if the instructions so indicate. With most types of rubbing compound, you should periodically add water to the mix as you work to compensate for evaporation and for the tendency of the compound to become less liquid toward the bottom of the container. Apply compound to a 2 x 2-ft. area of the car with a medium-sized paint brush or just toss a handful in the center of the area you're working on. Use just enough to achieve uniform distribution.

Without turning the polishing machine on, spread the compound evenly over the area with the polishing machine's pad. Don't apply compound directly to the polishing pad.

Drape the cord to the polisher over your shoulder, away from the spinning wheel, as it will take only a heartbeat to wrap the cord around the shaft if it touches the pad's edge. The polisher will rip itself out of your hands, and do a remarkably destructive whirligig death dance on your hood.

Turn the polisher on and smoothly stroke the area to be compounded left to right and then right to left. When moving the machine from left to right, lift the right half of the pad a little bit. When you stroke from right to left,

lift the left half of the pad a bit. In other words, the leading edge should be slightly above the surface of the area being compounded (Fig. 5). Each full stroke should overlap the stroke directly above or below by about half its width. Don't apply pressure as you stroke. Instead, just rest the machine against the surface. Let the weight of the machine do the work.

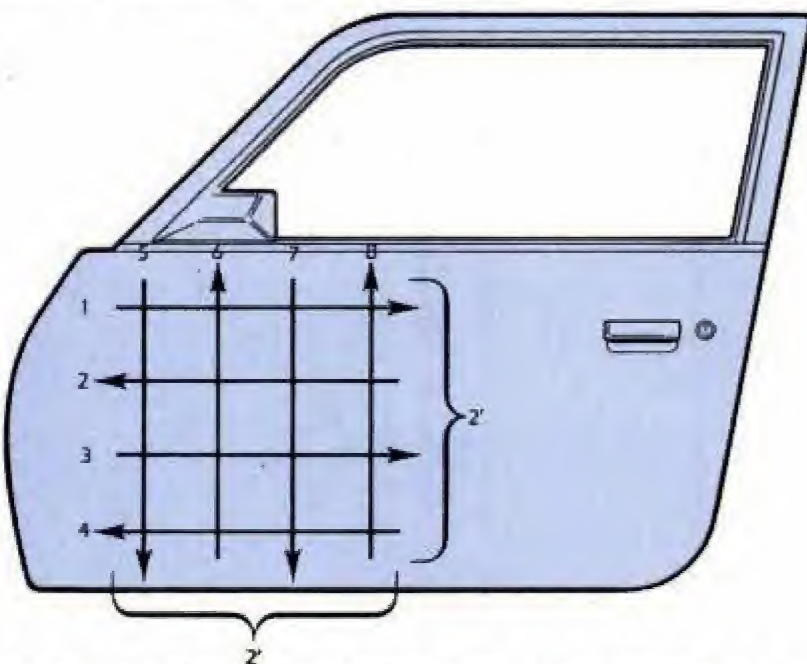
Once you've fully covered the area with horizontal strokes (it should take about four strokes), repeat the procedure using vertical strokes, but don't apply more compound. Figure 6 illustrates how eight strokes cover a 2 x 2-ft. section of door. If the compound is all used up before you've finished, you didn't use enough. If there's a lot of compound left on the surface, you used too much. In other words, by the time you've finished compounding vertically and horizontally, the compound should have disappeared and you should see a glossy surface. Or at least a glossier surface. If the damage is severe, and you're using the recommended fine-grade compound, it might take more passes. Patience is called for, as you can't go back after you grind down to the primer.

As you work, you'll have to clean the pad from time to time to prevent buildup of compound. To do so, lay the machine on the ground, pad facing up and turn it on. Grip the machine firmly and scrape compound buildup from the pad by passing a dull screwdriver over the pad as the machine runs. Move the screwdriver from the outer edge of the pad toward its center.

After you've compounded all exposed areas of the paint surface, remove the masking tape from the raised edges and corners and compound these spots by hand. You'll also have to hand compound areas under the edge of bumpers or spots that can't be reached with the machine.

Protecting the finish

Once the car has been compounded or polished, rinse it thoroughly with warm water and dry it with a chamois. To make your car shine as brightly as it would if a professional detailer had restored the finish, apply pure carnauba wax. Be sure to allow sufficient time for the car to dry. The carnauba will provide a layer of protection. It is essential that the wax does not contain any abrasive or it will remove more paint. Rub a bit between your fingers before you use it. As with the compound, apply wax to one small area at a time. Polish with a soft cloth.



6 To compound a 2 x 2-ft. area, stroke horizontally. Then repeat vertically.

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Transmission Trouble.

Q. I have a 1984 Saab 900 S, 4-cylinder with automatic transmission. When I shift into drive, the car won't move for three to four minutes. Do you think a transmission additive will improve the problem?

S.C., Camden, ME

A. We don't think so. Your transmission problems may be due to a bad pump pickup tube, a worn pump, or a fluid leak in the transmission valve body. We suggest taking your car to your dealer or a qualified mechanic to check the transmission line pressure and perform a stall test on the transmission. These two tests should direct him to the problem area.

Breaking In.

Q. I own a 1984 Cadillac Coupe de Ville and I'm putting in a completely rebuilt motor. In breaking in the motor, what weight of oil is best?

W.D.H., Las Vegas, NV

A. We recommend using a quality 10W-30 motor oil in your rebuilt engine, as this grade works well for a varying degree of temperatures. By quality, we mean an oil, like Pennzoil, that exceeds the API's highest standard for passenger car engines, SG/CD.

Aviation Oil.

Q. Would the use of Pennzoil Aviation Oil cause any harm to my car's engine?

R.M.S., Phoenix, AZ

A. We do not recommend the use of an aviation oil in your car's engine.



By Don Johnson

*Vice President, Product Engineering
Pennzoil Products Company*

Aviation oils are very different from car engine motor oils, and do not meet the warranty requirements of automotive manufacturers.

Vehicle in Limbo.

Q. How often should I change the oil in my car if it has been in storage for several months? And why?

G.E.F., Portales, NM

A. First, the best procedure is to change the oil and filter before putting the vehicle in storage. Then change the oil every three to four months. During long-term storage, water vapor (humidity) may condense on the inside surfaces of the engine. Pennzoil Motor Oil has additives to combat corrosion, but the vehicle should still be started each month and run for a short period of time to circulate the oil within the engine. This helps to maintain the protection of all parts.

Cold Weather Steering.

Q. I've been experiencing a problem with the power steering in my 1969 automobile. During cold weather, 30°F or below, the power steering does not operate properly on startup. After a few miles of driving—it's fine. What could be causing this?

J.K., Carnegie, PA

A. Power steering fluid can become so contaminated that it won't function properly at low temperatures. Try draining your power steering reservoir and refilling it with fresh fluid. If this doesn't work, you should have a qualified mechanic check your power steering system.

EDITOR'S COMMENT.

Whether topping off a power steering reservoir or completely refilling, always check your owner's manual for the correct fluid recommendation. Manufacturer's recommendations vary widely. Dexron II Automatic Transmission Fluid, Type F Automatic Transmission Fluid, or a fluid meeting GM 1050017 specifications are the most popular recommendations. Protect car warranties by following owner's manual recommendations.

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about motor oils, lubricants and engines. However, you can tell us a few things, too. Maybe you've discovered something interesting about motor oils or lubricants. Or you have a special reason for being a Pennzoil fan. We would like to hear from you. Write to: Don Johnson, Pennzoil Products Company, P.O. Box 2967, Houston, TX 77252-2967.



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TOURING FIRST CLASS (Continued from page 83)

strains it into distortion as speed increases. The tail trunk is spacious and all three luggage compartments are fitted with handy lift-out soft liner bags. The saddlebags are somewhat awkward to load due to their removable tops, but experienced touring riders know that this design is best for keeping rain out. Adjustments for the seat and handlebars adapt the bike to a wide range of rider sizes.

Among the Japanese nameplates in our group, the Voyager is a machine of least—least weight, lowest seat and shortest wheelbase. The suspension is air adjustable, but there's no onboard compressor as found on other machines. This may be serious to the 50,000 miles-per-year rider, but no one missed it on this tour.

Suzuki Cavalcade

Relatively speaking, Suzuki is the latecomer among builders of touring schooners, but they've made up for any tardiness in the comfort of passenger accommodations. Picture this: air-adjustable seat cushions inflated by the onboard compressor and full rear radio controls. The rider is also treated to a plush seat cushion which remains comfortable after many hours on board.

At the heart of the Cavalcade is a powerhouse 1360-cc V4 engine. The cylinders are inclined at an 82° spread which results in a noticeable, though not disturbing, vibration. Its muscular reserves were always welcome—at the price of the greatest fuel consumption of the group.

The Cavalcade makes tradeoffs that alternately work for or against the rider. The fairing has little weather protection at the lower extremities, welcome in warm weather riding but a loss on cool-season tours. The styling and trimwork is powerfully handsome, but the lack of ground clearance was an unwanted, unpleasant surprise.

Give Suzuki a pat on the back for the quick-removal mounting system used for the radio, which has a locking cover and automatic volume compensation. The saddlebag lids are fitted with convenient storage pockets and the fairing has a clear plastic map compartment.

The Suzuki offered the softest and most isolated ride in the group, a blessing over broken surfaces but less comforting when hotfooting through the hills.

Yamaha Venture Royale

Credit Yamaha with first proving that long-haul touring cycles could also be fun on a backroad sprint. Com-

bining a Monocross rising-rate rear suspension with electronic antidive control up front, the Venture Royale puts up no resistance when you're ready to hustle along on backroads.

The workhorse V4 engine contributes mightily to that ability, too. A 1294-cc 70° V4, it is close kin to the roadburning powerplant of the V-Max hot rod. On the dragstrip, only the Kawasaki Voyager topped its acceleration figures. The V4 does have an annoying level of buzziness, though, felt particularly in the footpegs, right at the pace most interstates encourage. Yamaha works to offset that with rubber mounting, but the handlebar mount proves disconcertingly elastic to most riders.

The layout of the V-type engine results in a relatively top-heavy feel to the Venture in spite of a well thought out seating position. The saddle is low and the dashboard ahead is higher, affording a nice "part of the machine" feel. The pitch of the seat, however, squirms the rider forward.

Yamaha's Venture series was the first full-dress-only model, and the Royale hasn't fallen behind the times. Standard equipment includes an automatic leveling system using an onboard air compressor, and an AM/FM stereo cassette sound system with built-in 40-channel CB radio.

Some degree of chassis tuning is afforded by the front and rear air-adjustable suspension units, of great value when carrying a weighty load.

Conclusion

Packing many miles into a few days tends to sort out the variables handily. Some conclusions are crystal clear: If you're heading coast-to-coast, fast, the built-in-America Honda Gold Wing is the undisputed No. 1 choice, both for its plush accommodations, velvet-smooth operation and over-the-road competence.

When the riding goes beyond the need to hurtle from A to B, though, further consideration is in order. The high-tech Honda advances touring into a generation beyond this one—truly it is in a class of its own. But that may not be what every motorcyclist wants.

All-around, the motorcycle that consistently delivers the most pleasing feedback is the Kawasaki Voyager XII. It's smooth riding without sacrificing sporty handling, and responsive without rough operation. Until our needs change, we'll stick with bikes that don't aspire to wipe out the sensory pleasures of 2-wheel travel. The Voyager XII best meets those requirements—with the most attractive price to boot.

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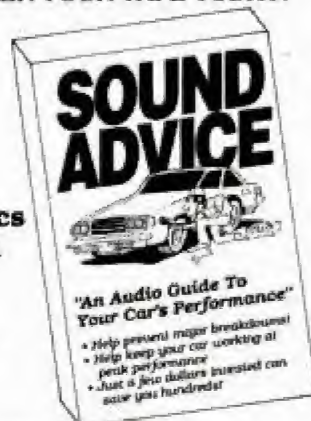
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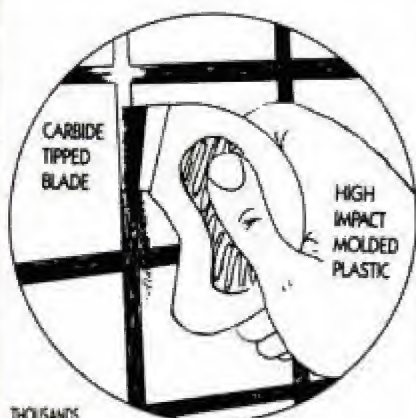
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RED TECH RISING (Continued from page 92)

and eggs. Even so, agriculture is considered an intensely critical aspect of Soviet life, affecting the nation's health, economy, foreign relations—indeed, its political survival.

Soviet experts—in this time of intense self-examination—admit that collective farming has failed to produce adequate food supplies. I met a 37-year veteran of a Belorussian collective who cited appalling failures in Soviet-made farm equipment, but also in centrally dictated farm policy.

Additionally, the Soviets have had to contend with the natural limitations of their climate—features that have shortened the growing season in soil that's hardly ideal.

As Nikolai Krasnoshchokov, vice president and academician at a Novosibirsk agriculture institute, explained: "The climate in Siberia—and other parts of the U.S.S.R.—is very harsh. It starts snowing in October and sometimes it doesn't stop until May. The soil of Siberia is also highly saline and highly compact."

The strategy, he continued, is to develop various "soil defense" methods and to shorten the growing season by introducing fast-growing crops. These methods have shown real promise in recent experiments, Krasnoshchokov said.

For instance, radiological techniques and biotechnical selection have reduced the growing cycle of certain strains of Siberian wheat from 100 days to 65 days—a concession to the brutal inevitability of the Siberian winter. These irradiation techniques have also made the varieties more disease and pest resistant.

To restore the soil, ploughs linked to hydraulic vibrators—first developed in Britain—are attached to huge gangs of equipment, from fertilizer applicators to weeders to seeders. The vibration ploughs permit lighter, more fuel-efficient tractors to pull the load, and the gang system allows farm managers to cope with the demographic consequence of World War II, in which the Soviet Union lost 20 million of her people. The population of middle-aged labor has declined, a factor that has mandated drastic redesigns in Soviet farm tools. In the future, modularized tools will be used that can be reconfigured according to the size of the job and the number of people on hand to perform it.

This manpower shortage—and the realization that large collectives have failed to provide for the nation's basic food needs—has persuaded agricultural planners to develop a much smaller farm of the future.

And, as Vitaly Lazovsky explains it: "Everything will be ecologically

clean, using recycling and closed industrial systems."

Four families will purchase equal shares in the farm through subsidized loans, working the land on a long-term lease arrangement that can be passed from generation to generation. Fish from a pond will be sold on the open market, with a portion of the stock serving to feed the poultry. Hog husbandry will provide the biggest source of income. Milk production will be increased with a unique machine that precisely duplicates the sucking pressure and frequency of a newborn calf. Manure from livestock operations will be used as fertilizer—and a manure conversion process currently in development will produce biogas to power farm tractors, trucks and other machinery. Minimal electricity will be drawn from public power grids. Instead, wind generators, photovoltaic cells and thermodynamic heat pumps will supply most power needs.

The entire system will work as a unit—drawing few resources from the outside, but earning maximum payback for its new owners. "Our future farms will be designed for new forms of labor organization," Lazovsky explained, little realizing that the private enterprise he envisions is as old as human nature.

All around the town

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To be sure, there's considerable economic incentive for a highly functional mass transit system, which also includes innumerable surface lines of trolley buses and trams. Getting people to work on time is crucial to state productivity.

But the Moscow Metro is also a source of considerable national self-esteem, accordingly to Eugene Gondazeveski, deputy director of the system. Three generations of Gondazeveskis have worked for the Moscow Metro, forming a kind of transit-worker dynasty that, Gondazeveski maintains, is one of the Metro's strengths. He says that 25,000 fellow

(Please turn to page 156)

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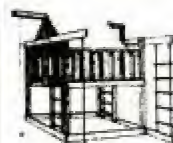


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RED TECH RISING

(Continued from page 154)

workers feel the same way as they
tend the Metro's vast fleet of trains.

The tracks come equipped with durable position sensors that establish spacing between trains and warn a centralized command station of breakdowns. Considerable effort is expended in meeting the system's complex light and ventilation requirements. The latter is crucial, as the Metro burrows deep beneath Moscow to double as a bomb shelter.

The Moscow Metro is also a fitting place to conclude this tour of Soviet technology. It's big. It's brawny. And it gets the job done. There's nothing particularly delicate, sensitive or elegant about the way it serves its design function—except for the marble and mosaics that decorate the system's major stations. In short, it's an appropriate metaphor for Soviet technology as a whole—a technology that continues to produce devices, systems and controls that are unique in all the world.

In the land that gave us Mendeleev, father of the periodic table of the elements, and Pavlov, still an authority on behavioral science, you now find the world's largest aircraft, the Antonov 225. This 6-engine stretch version of the AN-124 Condor was rolled out last fall, extending the Condor's already considerable range and payload. The MI-26 helicopter enjoys the distinction of being the world's largest vertical lift aircraft. The technology of "mosts" doesn't end there: punch presses, blast furnaces, hydroelectric dams, unique explosive welding techniques, plasma scalpels, intramuscular electro-stimulation devices, friction reduction using electron bombardment methods, large-scale seismology experiments using revolutionary deep-drilling techniques. All of these innovations sprang from the fertile minds of talented Soviet people striving to satisfy unmet needs.

But what's wrong with Soviet technology? Why hasn't it kept pace with international efforts, despite these isolated instances of world-class work? The reason, I think, can be distilled to a single precept: They seem utterly unable to move innovation from laboratory to the open marketplace, still an alien concept despite the first tentative steps toward a free economy under Mikhail Gorbachev's restructuring. Until the Soviet people learn to truly live by the simple efficiencies of supply and demand, their strides in technology will lag behind the rest of the world—which roars contentedly toward tomorrow. **PM**

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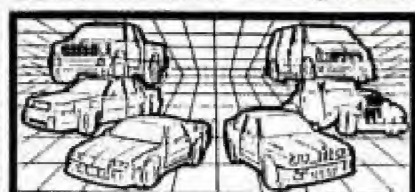
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(Continued from preceding page)

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